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Sarraceniaceae

mit 43 Einzelbildern in 10 Figuren
und einer Doppeltafel

von

J. M. Macfarlane.

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Sarraceniaceae

von

J. M. Macfarlane.

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(*Cisti* sect. 2. Adans. Fam. II. (1763) 450. — Incert. sedis, Juss. Gen. (1774) 435. — *Sarraceniaceae* La Pylaie in Ann. Soc. Linn. Paris VI. (1827) 379. — *Sarraceniaceae* Dumort. Anal. fam. (1829) 53. — *Sarraceniaceae* trib. *Nymphaeaceae* Endl. Gen. (1836) 901.)

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Character. Flores ampli 6—4-meri nutantes, in fructu nutantes suberecti vel erecti. Sepala vulgo 5, rarius 6 vel 4, libera, imbricata, saepe petaloidea, persistentia.

Petala vulgo 5 rarissime 0, libera, lutea ad purpureo-rubra, decidua. Stamina ∞ vel 15, libera, hypogyna, proterandra, filamentis attenuatis, antheris basifixis lateraliter dehiscentibus, pollinis granulis minutis ovoideis sulcatis. Pistillum syncarpicum, carpellis 5—3, sepalis oppositis vel cum eis alternis; ovarium 5—3-loculare, saepe tota superficie ± tuberculatum et nectariferum, placentis marginibus carpidiorum replicatis et angulo interno loculorum prominentibus, saepe centro ovarii non coalitis; ovula ∞ subhorizontalia, anatropa, raphe laterali; stylus inferiore parte simplex, cylindricus, apice simplex stigmatibus minutis vel ± expansus, radiatus, 5-lobatus, stigmatibus papillosis terminalibus. Capsula sphaerica ad ovata, 5—3-locularis, ab apice vel a lateribus loculicide dehiscens. Semina ∞, parva, testa crustacea vel laxe reticulata, albumen carnosum, embryo prope hilum, parvus, cotyledonibus lineari-oblongis.

Herbae perennes locis humidis et paludosis Americae crescentes. Rhizoma cylindricum internodiis saepius subnullis et foliis dense sese obtegentibus vel rarissime internodiis elongatis attenuatis et foliis ± distantibus, cicatrices foliorum subannulatae; radices ex rhizomate basi foliorum enatae. Folia petiolata, petiolo solido, basi alato et dilatato, amplexicaulia, monomorphia, dimorphia vel trimorphia; folia vernalia (pro ordine typica, in duobus generibus solum obvia) ascidiformia erecta suberecta vel procumbentia, saepe ± rubro-viridia vel viridia maculis rubris et albis notata; ascidia valde inflata tubulosa vel ventricosa, alae (i. e. dimidiae laminae p. 6) distinctae vel conjunctae ventre longitudinaliter decurrentes, ascidium apice dorsi in operculum erectum concavum vel cucullatum expansum, extus et intus ± villosum vel hirsutum et glandulosum; folia aestivalia si ascidiformia vernalibus conformia, si reducta verticalia viridia, costas solidas alis verticalibus instructas formantia; folia autumnalia brevia squamiformia, imbricata, acuminata, viridia vel rubra, per hiemem persistentia. Scapus erectus sub apice saepe inversus, bracteis ad scapum dispersis vel sub flores aggregatis, 6—1-florus.

Vegetative Organs (Vegetationsorgane). The ripe capsules of *Sarracenia* and *Darlingtonia* shed their seeds from July to September in their native haunts. Germination takes place in from three to five weeks, and a small seedling may be formed before Winter in the warmer Southern States, or germination may be delayed till the succeeding Spring in colder States. The radicle emerges through the micropyle and grows to a length of 2—3 cm, by which time the hypocotyl has emerged and elongated about 1 cm. Simultaneously the cotyledons grow, elongate greatly, and become green. Both are linear, their tips push upward the seed coat, and remain within it for a time, in order to absorb the albumen. One then usually frees itself, while the other continues to complete final food absorption. This is effected by soft elongated terminal epidermal cells of the cotyledons, which form slight papillar processes. When they have spread apart a succession of four to seven ascidiform leaves next develops, which are nearly vertical in all the species. In shape and relation of parts these closely resemble mature leaves of *S. minor*, which may well be regarded as the primitive type of the genus, a conclusion strengthened by many other characters. If the seedling has developed in the Autumn to the above degree a rest then occurs during Winter. In early Spring a second root arises at the junction of the radicle and hypocotyl, and this is succeeded, during the remainder of the season, by six to eight roots that start from the top of the hypocotyl, or from the short swollen stem. These roots attain an average length of 7 cm, and are beset with short irregularly bent side rootlets. Meanwhile additional leaves unfold, to the number of from 6—25, according to the species. These gradually assume the adult characters alike as to shape, position and color, so that by the close of the first complete season of growth the species can readily be determined. By this time also the epicotyl, from which the above leaves have developed, has either enlarged slightly (*S. psittacina* type), or has formed a tuberous swelling about the size of a pea (*S. flava* type), that is the rudiment of the future rhizome.

The adventitious rootlets above noted, arise each in the middle of a leaf base, but only as a rule from the lower and lateral leaves on a rhizome. Root hairs are

rarely formed on the main roots, but the mature roots of *S. Sledgei* have these in moderate quantity. The short bent side rootlets, that are abundantly formed by the main roots, are from 3—6 mm long, of uniform thickness, and are devoid of root hairs. Absorption of crude sap must therefore be effected by the soft general surface of the rootlets, as in some swamp and aquatic plants. The growth duration of the roots is strictly limited. A new set is formed annually on mature rhizomes, to the number of 5—8. These have attained full growth by the close of the season, but they continue to function for six to seven years as food storers. Gradual decay then sets in, so that large rhizomes of *S. flava* or *S. Drummondii* that measure 25—30 cm long, only show functional roots over their anterior 15 cm. In color the mature roots of *Sarracenia* are yellow-brown to red-brown, from a pigment present in the cavities and walls of the epidermal cells. The interior is white, from the abundant starch and protein substance that are stored in them up to the period of decay.

The epicotyl or young stem, during the first full season of growth, forms a small swelling in *S. purpurea*, *S. psittacina*, and *S. rubra*, that consists of nodes to which the amplexicaul bases of the leaves are attached. In *S. Sledgei*, *S. flava* and *S. Drummondii* the swelling may be as large as a pea. From its lower and lateral surfaces the adventitious roots arise. In subsequent years horizontal growth and increasing enlargement of the axis give rise to the mature rhizome that is typical of each species. This may continue to grow horizontally for at least twenty to thirty years, and during the period it may give off a few lateral subterranean buds, which may develop into separate plants by formation of roots and leaves, followed by decay of the parent axis up to their points of origin. The rhizomes may attain a length of from 6—7 cm in *S. rubra* and *S. psittacina* to 30 cm in *S. flava* and *S. Drummondii*. The older end decays slowly, the middle portion shows only leaf scars and decaying roots, the anterior end shows decaying, fresh and developing leaves along with functional roots. Each rhizome is made up of closely applied nodes, from which spring the leaves and flowers, both of which are inserted into it by broad shallow amplexicaul bases, that ensheath the axis for three-fourths to seven-eighths of its circumference. Rarely in *S. purpurea* and *S. psittacina*, when growing in soft swamps or in water, the internodes of lateral branches may elongate, so as to distribute the leaves at distances of 5—15 mm apart. The leaves arise in spiral series around the growing apex, and on withering each forms a scar on the rhizome that is widest at the middle region of insertion, and that narrows out toward the margins. The broken ends of the leaf-trace bundles appear as minute brown spots over each scar. These consist of a double row of vascular bundles — an anterior and a posterior — so disposed that any two bundles of one row alternate with those of the other. Only toward the margins of the scar is one row indicated. The cicatrix left by each withered flower stalk is similar to those of the leaves, but is deeper in its attaching surface.

The stem in *Darlingtonia* forms slightly more elongated internodes than in *Sarracenia*, so that the leaf bases are less crowded together, while the leaves start from it in more oblique direction. Perennial growth proceeds for at least 10—15 years, accompanied by slow decay behind. Lateral branches are occasionally formed as in *Sarracenia*, but these rapidly lengthen out from the parent axis, by the formation of internodes 2—3 cm long, and of nodes from which spring a sheathing scale leaf and a root. At the extremities of such branches leaf rosettes and roots arise. In two or three years each rosette becomes a separate plant that shows slow growth of the rhizome, and that bears crowded leaves. The roots and rhizomes alike are of a cinnamon-brown to dark brown color, from pigmentation of the epidermal cells only.

The leaves are complex morphologically. Varied and often widely divergent views have been expressed during the past hundred years regarding these. St. Hilaire, Duchartre, Lindley, Baillon, A. Gray, Zipperer, Macfarlane, Goebel and Krafft have advanced their own views, and often reviewed those of their predecessors. The following account is set forth by the writer as that which seems most in agreement

with embryological, morphological, evolutionary and taxonomic evidence, and is more fully treated in the Annals of Botany [III. (1889) 253]. There, however, he accepted the terms dorsal and ventral in a sense that now seems to him inappropriate, and in the succeeding descriptions he has returned to the older usage of "ventral" for the upper, and "dorsal" for the under leaf surface.

A comparative study of the leaves of *Heliamphora*, *Sarracenia*, and *Darlingtonia* shows that they are related to each other in advancing specialization in the order named. In *Heliamphora* the seedling and adult leaves are fundamentally alike, and consist of a petiolar midrib that bears at the base wide sheathing membranous wings (Fig. 1 *Ba*). These become slightly contracted above the base of insertion as in many species of *Nepenthes*, but again reexpand to form petiolar wings (*b*) in front of the midrib. The latter becomes inflated and excavated, from near the leaf apex downward, to form the pitcher (*d*). In front of this the wings that again have contracted, reexpand into the halves of the lamina, that appear as longitudinal foliar excrescences diverging from each other, and from the pitchered midrib that bears them (*e*). The homological relation here with many species of *Nepenthes* is perfect. In small young leaves of *Heliamphora* the margin of the orifice of the pitchered midrib, is rather sharply reflexed on either side to form a narrow collar, but in adult leaves the top of the pitcher gradually widens out into a straight margin. In seedling and in small adult leaves, the posterior midrib apex is slightly prolonged above the mouth into an acuminate process, but in larger leaves this bears lateral laminar expansions that together form a circular or ovate lid (Fig. 2 *A*). This lid is constricted off from the pitcher orifice, and may measure 10—15 mm across.

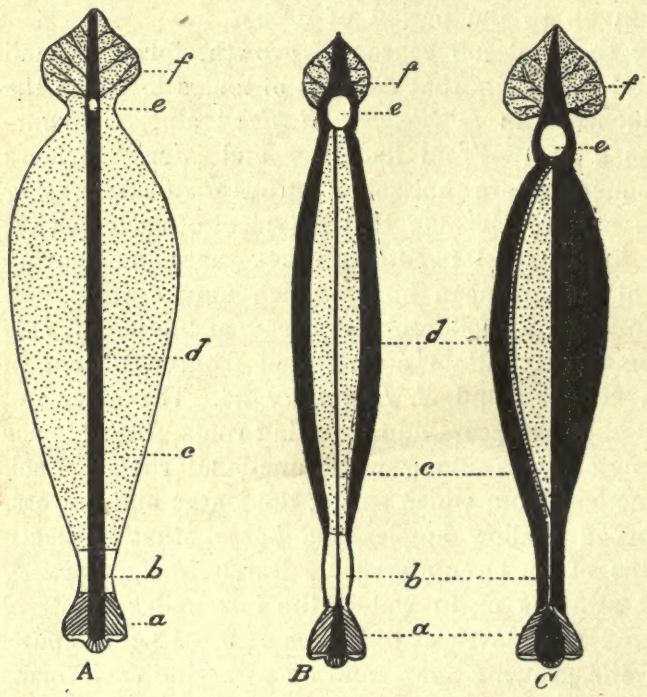

Fig. 1. Relation of leaves in *Sarraceniaceae* to simpler leaf type. *A* Diagram of simple leaf type. — *B* Diagrammatic leaf of *Heliamphora*. — *C* Diagram. leaf of *Sarracenia*. *a* sheathing base of petiole, *b* winged (*A*, *B*) or cylindrical (*C*) part of petiole, *c* expanded (*A*, *B*) or fused (*C*) halves of lower laminar portion, *d* uniform (*A*) or inflated and pitchered *B*, *C* midrib of lamina, *e* supposed (*A*) or actual (*B*, *C*) invagination orifice in pitcher formation, *f* terminal lobes of lamina (*A*), that form lateral parts of lid in *B*, *C*. (Original.)

Each annual growth of leaves of *Sarracenia*, in contrast to those of the two other genera, is always dimorphic, and frequently trimorphic, but easy gradations from one type to another can often be noted. The three types are: (*a*) petiolar scale leaves, that function as winter scales, and are present in all the species, though in variable number; (*b*) pitchered leaves that act as animal-chiefly fly-traps, and which apart from the scales are alone developed in *S. rubra* and *S. minor*, are chiefly formed in *S. psittacina*, *S. purpurea* and *S. Sledgei*, and are about equally or rather more abundantly produced in *S. flava* (Fig. 10 *b*, *c*) and *S. Drummondii* than are those of category (*c*). Those of type (*c*), which might be termed "laminar phyllodia", clearly represent reduced pitchered leaves that have developed a petiolar and inferior laminar portion, but have failed to produce the superior pitchered part of the lamina (Fig. 10 *c*). That the second or pitchered leaf is the primitive type for the genus, from which the first and last have been derived, is shown by these always and only being formed on the seedling

plants, the other types — *a* and *c* — appearing later as reduced and modified derivatives from it. The writer has examined hundreds of seedlings of all the species, but has found no exception to the above rule. These types will now be described in the order above given.

The petiolar scale leaves (*a*) originate round the growing apex of the rhizome during the summer that precedes the winter through which they function. They vary in number from two or three in *S. purpurea* (Fig. 4), to 9—12 in *S. psittacina* (Fig. 3 *a*). Each consists of a broad sheathing base, whose median area is the expanded petiolar rib, and whose margins are the basal parts of petiolar wings. The midrib is prolonged upward for 2—4 cm as a tapered cylindrical process, and along its ventral face the basal wings gradually come together, fuse, and taper into a fine line some distance beneath the apex of the rib. As will be fully explained later each scale bears numerous honey glands, which are to be regarded as ancestral remnants of those that functioned when the scales were pitchered leaves. The pitchered leaves (*b*) show great diversity of form according to the species. In the description of seedling growth it has been stated that all of the species first produce 6—8 leaves of increasingly larger size, but that closely resemble adult leaves of *S. minor*, which for many reasons is to be regarded as the primitive species of the genus. Each seedling leaf consists of a cylindrical petiole that widens below, and sheaths round the plumule or epicotyl. The expanded margins or wings of the sheath become confluent and continuous upward as a delicate line or ridge along the ventral face of the petiole and of the hollowed-out laminar midrib above. As compared with *Heliamphora* therefore, the midrib portion of the lamina has specially enlarged at the expense of the laminar wings, which are fused and reduced to a ventral line or ridge. This conclusion is verified, alike by comparison of seedling with adult leaves, and of these with leaves of *Heliamphora* and *Darlingtonia*. The dorsal extremity of the midrib in the seedling leaf widens out, arches upward and forward to form a concave lid that almost covers the orifice, as in adult leaves of *S. minor*. But from the radiating distribution of veins into the lateral margins of the lid, and comparison of this with adult lids, the writer concludes that these expanded margins of the lid represent expansions of the lamina, which have become separated from the reduced lamina that appears as a line along the ventral face of the pitchered midrib. Additional proof is furnished below.

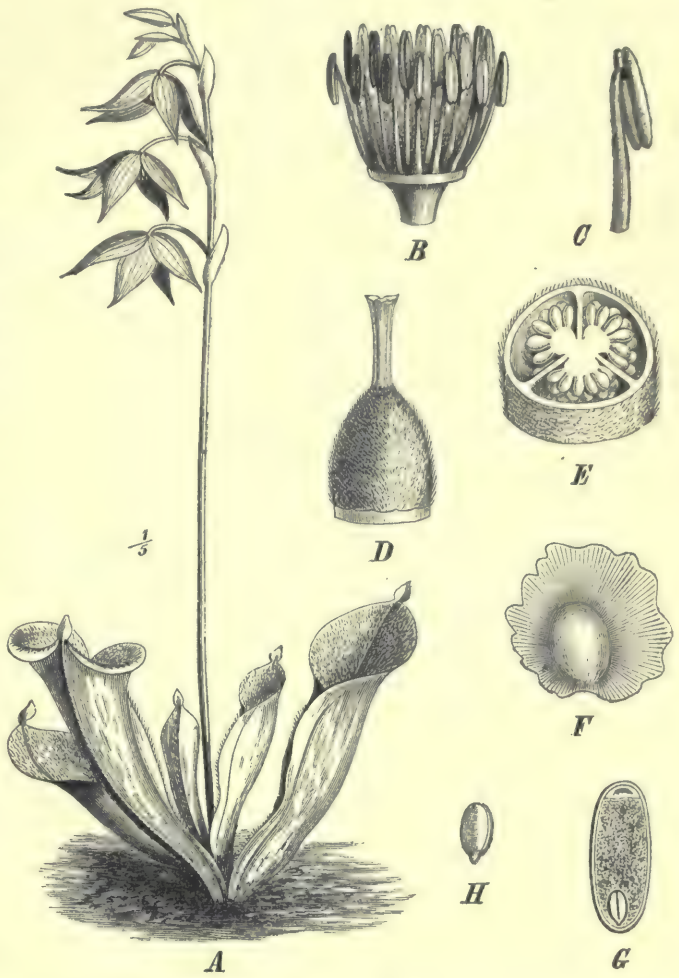

Fig. 2. *Heliamphora nutans* Benth. *A* Entire Plant. *B* Androecium. *C* Stamen. *D* Pistil. *E* Transverse section of the ovary. *F* Seed, with the testa. *G* Vertical section of the seed. *H* Embryo. (Cop. from Engler-Prantl, Pflzfam. III. 2, p. 252 fig. 151.)

Toward the middle or latter part of the first complete season of growth, decided specific characters are indicated. The leaves of *S. purpurea* and *S. psittacina* become increasingly spread out, till those of the latter assume a horizontal position; both also become crimson-veined and flushed with crimson if sun exposed. The latter species begins to show small pale areolae over the top of the pitcher, that is now strongly contracted and overarched, so as to bring the orifice into a vertical position. The lid in *S. purpurea* has become vertical, or slightly inclined backward, and shows a wavy margin. Pitchers of *S. minor* exhibit faint areolae over the posterior top of the tube. In *S. Drummondii* similar areolae appear, while the lid becomes erect,

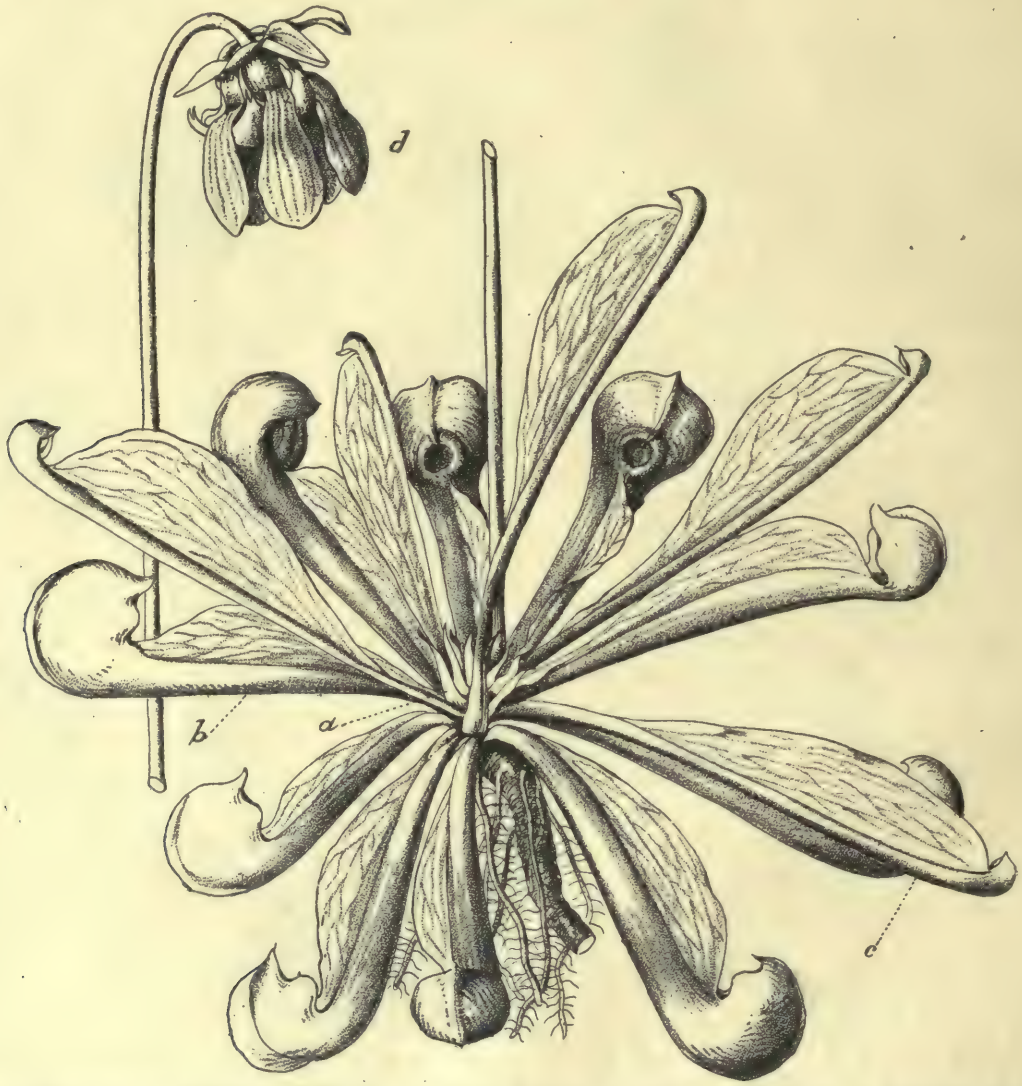

Fig. 3. *Sarracenia psittacina* Michx. *a* scale leaves, *b* pitchered leaves, *c* laminar phyllodia, *d* flower. (Original.)

and its margins frilled. In the other species less striking modifications are shown. But in all, one important growth development consists in the striking increase of the ventral laminar wing, which from being a mere line or ridge in the early seedling leaf, has now expanded into a prominent median flap, that is continuous from the upper part of the cylindrical solid petiole to the pitcher orifice. This corresponds to the similar wing in *Darlingtonia*, and results from fusion of the two free laminar wings seen in *Heliamphora* (Fig. 1 *Bc*, *Cc*), as histological evidence will show. It attains its greatest relative size in the pitchered leaves formed during late summer in *S. purpurea* and *S. psittacina* (Fig. 3 *c*). Thus in a large leaf of the former, that was 26 cm long, the pitcher was 5 cm across, while the wing was 6 cm. Greatly

more striking were the leaves on a semi-aquatic plant of the latter, gathered by the writer during winter near Ochesee, Fla. One leaf was 21 cm long, the pitcher was a long narrow tube 15 cm × 0,5 cm, but the wing was 17 cm long, and at its widest part 6 cm deep. A double set of vascular bundles runs into the wing from varying heights of the midrib, and distribute themselves over either face of it as reticulate veins.

The lid varies in size and morphological relation in the different species. In *S. rubra* and to less degree in *S. Sledgei* and *S. Drummondii*, it is slightly but more or less concave, and of ovate or nearly circular outline. Here it is separated from the pitcher mouth by a constricted neck, into which pass the longitudinally disposed pitcher veins, that have ascended dorsally, or that have curved round the mouth and reformed by fusing, before passing up into the lid. Traversing the median dorsal part of the tube, and prolonged into the lid is a vein that ends in the organic apex of the lid as an acuminate process (*S. rubra*, *S. Sledgei*), or that may become excurrent as a free process that is abundantly loaded with honey glands, as in some leaves of *S. flava*. When such is formed, the laminar substance of the lid may grow forward as a slight peltation beyond the excurrent point. Similar growth, to a more pronounced degree, causes a peltate fusion in *S. psittacina* (Fig. 3) beneath and in front of the beak-like apex of the vein, which can scarcely be said to be excurrent, though strongly protruding. The reunited veins from the pitcher wall also run up into the lid, parallel to the median one, with which they form anastomoses, and then distribute radiating lateral veins into the laminar halves of the lid. Morphologically therefore these should be regarded as laminar lobes, developed on either side of the prolonged and flattened neck of the midrib (Fig. 1 *Cf*). In *S. minor* the lid scarcely differs from that of the seedling, except that it becomes more arched.

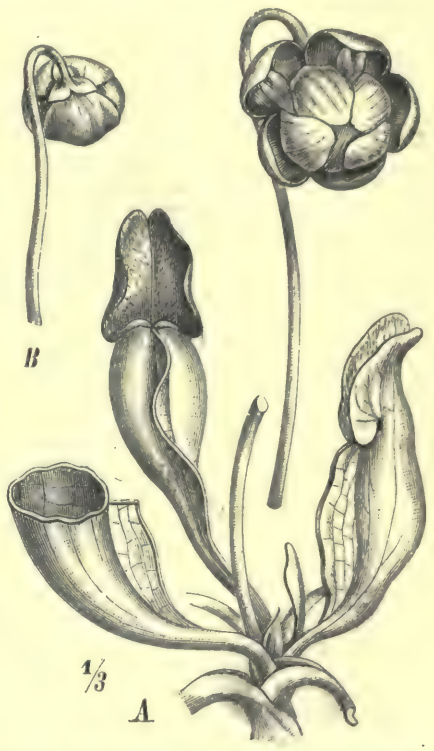

Fig. 4. *Sarracenia purpurea* L. *A* Habit.; several leaves and a part of the inflorescence removed. *B* Flowerbud, showing the calyculate bractlets. (Cop. from A. Gray, Gen. fl. amer. ill. t. 45 and Engler-Prantl, Pflzfam. III. 2, p. 246 fig. 147.)

Embryologically each pitchered leaf arises near the growing apex of the rhizome as a conical papilla with expanded base. Along its ventral aspect a median ridge arises, and above this, in line with it, an oval depression appears, the rudiment of the future cavity. The writer regards the ridge as the fundament of the lamina. The future pitcher thus arises as a ventral median depression of the midrib at the apex of the fused laminar halves, and slightly beneath the organic apex of the leaf. As growth proceeds the steadily deepening depression occupies an increasingly large area of the medullary tissue of the rudiment. The median ridge or crest continues to grow out as the future laminar wing, while between this and the sheathing base a solid cylindrical part lengthens to form the upper area of the petiole. The apex of the rudiment, at a later period, lengthens into a terminal process, on whose edges arise two closely involute outgrowths, the laminar halves of the lid. When mature the entire leaf thus consists of (a) a petiolar portion, and (b) a pitchered laminar portion. The former is made up of a broadly sheathing base, whose wings higher up converge into a faint median line on the ventral face, and of an upper solid cylindrical portion. The latter (b) consists of the greatly enlarged and pitchered midrib, that bears on its ventral face two fused inferior lobes of the lamina as a median wing. Goebel is evidently in error when he considers that the occasional bilobed or two-ridged condition, sometimes observed in the wing, is to

be explained as a peltate leaf-fusion, with the edges turned out. Such a condition is frequent in *S. minor*, another proof that it is a primitive type, and that in this it approximates to *Heliamphora* pitcher, with its distinct laminar halves.

The midrib is prolonged beyond the level of the pitcher rim, as a broad flattened expanse — the neck — and continued upward it bears two distinct laminar lobes, that form with it the lid. More or less divergent opinions from the above, have been held by several writers, but in view of the thorough studies by Krafft on *Heliamphora*, that confirm the present writer's observations, and from additional recent studies by him, the above seems to him the only exact and connected explanation that can be held.

Only one crop of foliage leaves may be produced annually, and all of these may be pitchered, as in *S. minor* and *S. rubra*, or two crops of pitchered leaves may be formed, that differ markedly in shape, as in *S. psittacina* (Fig. 3 *b*, *c*) when the plant is grown in its native haunts, or in hot bright sunlight. Then a Spring set develops with short rather wide pitchers, and enlarged areolate hood of a bright color. These persist for fully a year. But in front of them an Autumn set is formed (Fig. 3 *C*), in which each leaf consists of a long narrow pitcher with small hood, and of a wide median wing directed vertically upwards. In the native haunts of this species, where warm bright suns prevail from March to November, the alternating succession of dimorphic pitchers is pronounced, but in colder and less sunny regions, the two are apt to run into each other. In *S. Drummondii* pitchered leaves alone are developed in Spring, and last till October or November. But in September a new crop is produced, half of which may be pitchered, and half may be laminar phyllodia. These persist till April or May of the next season. But in *S. flava* the most pronounced dimorphism in foliage leaves is seen. The leaves of Spring are all pitchered, but they become gray-brown and withered by September, in the native haunts of the species. During August and September laminar phyllodia unfold, that have been formed in the bud during early Summer. These remain green throughout the Winter and into May and June of the next season. *S. Sledgei* in behavior is intermediate between *S. minor* and *S. flava*.

Coolness, shade, and abundant moisture are all cooperating environmental factors in reducing the pitcher cavity, and in stimulating the formation of the laminar wing. Mention of these factors leads to the consideration of the color assumed by pitchered leaves. In *S. purpurea* and *S. psittacina* these are of a deep claret-crimson hue, when fully exposed to bright suns during a large part of the year, but such tend to be smaller than others grown in the shade. The shaded plants may vary from greenish crimson to green in exact ratio to the degree and density of the shade. When plants, that were originally richly colored in the wild state, are grown under shadier conditions, the new leaves assume a greener hue. Similarly, while the pitchers of *S. rubra*, *S. flava*, *S. minor* and *S. Sledgei* are green or yellowish green, growth in very sunny and rather dry places often causes them to be reddish-green to red-yellow. But some peculiar and as yet inexplicable variations occur. Thus in not a few localities of the Southern States visited by the writer, all transitions have been noted in plants of *S. flava* that grew indiscriminately together, from pale yellow-green to the dark crimson sport *atro-sanguinea*. Equally puzzling is the color-variation in *S. Sledgei*, which in the same open savannah may vary from yellowish green to a uniform dark claret. Possibly such may indicate long continued and hereditary color acquisition from individuals that originally grew under different environmental conditions, but the rapid changes shown under cultivation seem to weaken such a conclusion. *S. flava* is the species that shows greatest color variation, and so has received a greater number of varietal names than the others, especially from horticulturists. In all other morphological details it is a very constant species.

The third type of vegetative leaf is the «laminar phyllodium». This seems never to be produced in *S. minor* and *S. rubra*, is rarely formed in *S. Sledgei* and *S. psittacina*, is occasional in shaded plants of *S. purpurea* (when it gives rise to Eaton's variety or supposed species *heterophylla*), is about as abundant as the autumnal

pitchered leaves of *S. Drummondii*, and is the only autumnal — or more strictly summer — set in *S. flava*. Each is composed of the lower sheathing petiolar and of the upper cylindrical petiolar parts below, that are prolonged upward into a shortened laminar midrib and laminar flap or wing, the upper and larger pitchered portion having failed to develop. That such is the correct explanation is proved, as Goebel has suggested (Pfl. Schild. II. 1. 73.), by the occurrence of transition types between laminar phyllodia and pitchered leaves. Further one can nearly always note, in front of the acuminate apex of the former in *S. flava*, a slight elliptic depression, that is a faint rudiment of the arrested pitcher.

The structural demarcation into areas of the outer and inner surfaces of pitchered leaves, as well as the relation to each other of the zones that excrete nectar, both visible to the naked eye, can best be explained and understood after study of the anatomical structure of the leaves.

In *Darlingtonia* the seedling and the reduced leaves conform to those of *Heliamphora*, except that the petiolar sheath is alone developed, while the continuations upward of its wings have here fused to form a delicate line or ridge, that runs along the ventral part of the pitchered midrib. Such leaves then conform closely to those of *Sarracenia* above described. Further the midrib vein of the pitcher apex is prolonged into a fine process, that represents the midrib of the *Sarracenia* lid (Fig. 9). The lid of the seedling in this genus is thus more simplified than are those of *Heliamphora* or *Sarracenia*. The adult leaf forms an ample membranous petiolar sheath that encircles the rhizome. The wings of this are prolonged upward as membranous lamellae, that diverge from each other and from the midrib, that is hollowed almost to its point of insertion into the rhizome. The petiolar wings then fuse gradually to form the ventral laminar wing, that is slightly developed below, but widens upward to near the pitcher margin, into which it merges. The terminal circumoral part in this genus is more complicated than in the other two, and is only approached by that of *S. psittacina*. The upper posterior or dorsal, and the dorso-lateral parts of the pitchered midrib, are prolonged into a cucullate hood or chamber, while the anterior or ventral part remains arrested. The orifice of the pitcher is thus rotated through an angle of 180°, and faces downward, instead of upward. An expanded bilobed process grows downward from the incurved anterior extremity of the hood. The writer regards this as the homologue of the lid in *Heliamphora* and *Sarracenia*, alike from its relation to the pitcher extremity, from its double radiating vascular system, and from its development of glands and hairs. The lid therefore depends in this genus, instead of being directed upwards as in the other genera, and this owing to alteration in direction and relation of the mouth. While the pitcher margin is more or less expanded or reflexed in *Heliamphora* and *Sarracenia*, it undergoes considerable involution in *Darlingtonia*. A conspicuous feature of the hood here is the series of transparent or translucent areolae, that are scattered over it, and whose structure is described later (p. 14). They agree with those of *S. minor*, *S. Drummondii* and *S. psittacina*. In this genus scale leaves seem only to be formed on the elongated side branches. Each is an ovate membranous sheath that surrounds the branch in amplexicaul manner.

Anatomy (Anatomische Verhältnisse). The developing seedling root, and the subsequently formed adventitious roots in *Sarracenia* are pentarch to hexarch. Each shows a shallow epidermis with thin cuticle. The young epidermal cells with increasing age gradually assume a yellow-brown hue, from pigment substances contained in the cell cavities. A hypodermal cortex of three, rarely as in *S. purpurea* of two, layers early develops in the form of rather large cells with lignified walls, the outermost layer being largest and most lignified. The medio- and endo-cortex consist of loose cells that enclose a circle of large irregular intercellular spaces formed on the outer side of the endocortex. All of these cells early begin to store ovate to obovate starch grains that are embedded in finely granular protein substance. Starch is also contained

in the lignified hypodermal cells. The endodermis is an evident layer of bead-like cells, with the usual radial wall thickening. Within it is a single pericambial layer, from which originate the numerous short lateral rootlets, each in line with a protoxylem tract. The bundle system consists, in its proto-elements, of 5 to 6 deep wedge-shaped patches of protophloem, between as many protoxylem arms. The protophloem shows a mass of small centrally placed cells, surrounded by large sieve tubes. The protoxylem is made up of a few spiral tracheae at the ends of the arms, of highly lignified fibre-cells in clusters or as isolated elements, and of starch-storing companion cells, that surround and unite the fibres.

Secondary growth proceeds by formation of cambium on the inner faces of the protophloem patches, and the development by it of metaxylem and metaphloem. The metaxylem consists of tracheids, of food-storing cells, and of large vessels with pitted lateral walls and oblique scalariform septa. No metaphloem is formed as a rule on the outer side of the root cambium, which is therefore operative only on its inner side, but occasionally two layers of tissue are produced on the inner side of the pericambium that serve to unite the protophloem patches. The short lateral rootlets all arise in the pericambium, and as many as three may be sectioned in one plane.

The roots of *Darlingtonia* agree closely in description with that given above, except that the three hypodermal layers are little if at all thickened, while the inner cortex is denser and more continuous. The number of radial vascular patches, also the mode of origin and the constitution of these, agree in both.

Stem. In *Sarracenia* the epidermal layer of mature rhizomes is of a brown color as in mature roots. This is again due to a pigment in the cell cavities, which early filters into and pigments the walls. Subjacent to the epidermis are two to three layers of indurated hypodermal cells, the outermost of which are most strongly lignified. These contain considerable quantities of starch. Subjacent is a wide zone of food-storing cortex cells, that are continuous in appearance and food-storing capacity with cells of the medullary rays and of the pith. Embedded in this extensive mass of storing cells is a discontinuous ring of vascular bundles of varying size and shape, and that are separated from each other laterally by medullary rays of very unequal width. Each fully formed bundle shows, next the pith, a few (2—5) spiral tracheae, surrounded by companion protoxylem cells. Outside these are one or two small isolated patches of pitted tracheids, surrounded by companion cells. The bundle then assumes a highly lignified character, and consists of metaxylem, in which a heavy patch of wood tracheids or fibres occupies the front part. This is succeeded by a mass of intermixed pitted vessels and wood fibres. Beyond the intrafascicular cambium of each bundle is a patch of normal bast or phloem. Slow and limited increase of each bundle goes on for 5 to 8 years, but no recognisable difference can be traced in the annual growths, that would demarcate them into rings.

In *Darlingtonia* the epidermal layer is likewise brown. Two to three hypodermal layers with slightly thickened walls, are succeeded by a broad rather dense cortex, that stores only a moderate amount of starch. The walls of the cells of this zone are somewhat thickened, and are traversed by canals with pore plates in their middle. The endodermis is a sinuous layer, of rather large cells, that bounds the pericambium. This consists of one, or by early division of 2—3 layers of thick walled cells, that simulate a fibrous phloem zone. Unlike *Sarracenia* the present genus forms a continuous cylinder of vascular bundles, from which leaf-trace bundles and root bundles are given off. The only slight point of difference here, as compared with *Sarracenia*, is that the tracheids and pitted vessels are more uniformly intermixed. But the structure of the leaf-trace bundles is exceptional. As each trace separates from the stem ring, the phloem closes in round the xylem, and from near the point of separation up to the insertion of the leaf, the bundle is a typical concentric one. It consists of a central xylem surrounded by a zone of phloem, that is made up of patches of phloem cells united by sieve tubes. The whole is enclosed by an indurated pericambium and

accessory cortex tissue. Slightly above the base of the petiole the 3—5 concentric bundles that have entered it, break up into parts that orient themselves bifacially, and then run lengthwise into the pitcher-walls.

Leaves. Since the pitchered leaves of the *Sarraceniaceae* are highly specialized in histological detail for an exact physiological purpose, they can best be studied from the histological standpoint when the physiological use is kept clearly in view. Since the epidermal surfaces are the important areas connected with the catching of animal prey, these deserve special consideration. Following the nomenclature of Hooker f. and of the writer, it may shortly be said that the external epidermis of each leaf is well supplied with honey glands, and in a few species with up-directed hairs that tempt small animals, chiefly insects, toward the pitcher mouth. The entire outer epidermis may therefore be named the "alluring" surface. The inner face of the lid in *Heliamphora* and *Sarracenia* (Fig. 5 *Ba*), and the inner face of the bilobed flap, as well as that of the cucullate hood in *Darlingtonia*, are richly studded with honey-secreting glands, interspersed with down-directed hairs. This region can appropriately be designated the "attractive" surface. Succeeding to this is an extremely smooth area that affords very insecure foothold for insects (Fig. 5 *Bb*), and from which they readily drop deeper into the cavity. This has been named by Hooker the "conducting" surface. Beneath is a deep zone that often covers nearly the entire lower half of the cavity, and that bears long tapered downwardly directed hairs. This is the "detentive" surface (*d*). The lowest part of the tube may at times be quite smooth, and may, like a considerable portion of the detentive surface, show a shallow thin-walled epidermis. Though scarcely deserving separate designation it may be termed, for convenience, the "absorptive" surface.

In *Heliamphora* each leaf shows many nectar glands over its external surface, from the base upward to the orifice. Along the laminar wings these glands are about twice as abundant. Each gland consists of a patch of 6—8 cells over the lower part of the pitcher, but of 9—12 in those near the orifice. Distributed amongst them are bifurcated upwardly-directed hairs of rather delicate texture. The entire region forms the alluring surface. The inner surface of the relatively small lid is covered with nectar glands of comparatively large size, and of complex structure as seen in surface view (Fig. 5 *Da*, *b*) and in section. These may be intermixed with others of smaller size, and this latter type persists amongst downwardly directed hairs over $^1/_3$ to $^1/_2$ of the pitcher depth. Both areas evidently represent the combined attractive and conducting surfaces. A smooth surface next succeeds. Its cells have wavy walls, and though devoid of glands the zone seems to be comparable to the glandular surface of *Sarracenia purpurea*, that will afterwards be described. The lower part of the tube is covered by wavy epidermal cells, from a few of which short heavily thickened hairs originate (*e*). This is the detentive surface.

The epidermal areas in *Sarracenia* vary somewhat according to the species, but broadly agree in general details. In every species the external epidermis develops numerous alluring glands, but upwardly directed hairs are absent, except in *S. minor* and *S. Drummondii*, where they may be irregularly directed, or may point upward in advantageous manner. In *S. flava*, *S. minor* and *S. rubra* the alluring glands are much more abundant over the laminar wing than over the general pitcher surface, so that this forms a special baited pathway upwards. The condition seen in *S. flava* is specially noteworthy, for here in addition to glands over the general surface and along the laminar wings, many are disposed along the strong prominent longitudinal veins of the pitcher. During May and June these exude large glistening nectar-drops that are highly relished by insects. In this species also, and to a less degree in the others, the external rim of the lid is richly covered with nectar-glands, that act as an allurement near the attractive lid surface. Stomata are abundant over the entire exterior of the pitcher and over the wing, down even to the amplexicaul base, where however they become scant. They are wholly absent over the upper surface of the amplexicaul

base, which is the only exposed area of the morphological upper leaf surface, outside the pitcher areas. That restriction of stomata to the lower epidermis is not constant, is proved by the abundance of them over the attractive inner lid surface, which is a portion morphologically of the upper leaf surface.

The inner lid surface that forms, with the margin of the pitcher, the attractive region, shows many glands like the external ones. These are set amid epidermal cells with wavy walls, and amongst them occur stomata in greater or less quantity according to the species. But a conspicuous feature of the region is the bristling mass of downwardly directed hairs, that vary in size and shape according to the species. Each hair is a strong unicellular thick-walled outgrowth from an epidermal cell, whose surface is beautifully and delicately striated or fluted longitudinally (Fig. 5 *Cb*). These hairs attain greatest length and strength in *S. Drummondii*, where each may be 1—1 1/2 mm long. They may be as long but are more slender in *S. psittacina*, they are strong though slightly shorter in *S. purpurea*, while *S. Sledgei*, *S. minor*, *S. flava* and *S. rubra* show decreasing length in the order indicated. By their direction these incline insects to move downward toward the next or conducting area now to be described. The demarcation between the two areas may be indicated by a sharp line across the lower part of the lid, as in *S. minor*, *S. purpurea* and *S. psittacina*, or the two may gradually merge into each other as in *S. Drummondii*. In *S. minor* alone, glands identical with all of the above, extend down over the conducting to the upper part of the detentive surface, and though the lower ones do not secrete nectar, such a continuous distribution would suggest that nectar excretion may primitively have been the only function of the glands. In *S. purpurea* the glands are continued down only to the edge of the detentive surface, while in *S. flava* and *S. Drummondii* they form a long descending glandular tract along the posterior part of the conducting surface.

The conducting surface in every species has each epidermal cell prolonged into a delicate pointed process with finely striated wall, except in *S. purpurea* where the process can scarcely be said to exist, or is a mere papilla from the lower part of each cell-wall (Fig. 5 *Cd*). The resulting imbricated system is of extreme smoothness and evident insecurity to insects. These totter, scramble and usually at length slide off into the deeper parts. Rich excretions of nectar may be exuded over this area, specially in its upper limit near the pitcher orifice, and upward along the posterior neck to its junction with the attractive lid surface. In sharp contrast to the "attractive" epidermal cells, those of the "conducting" surface are straight-walled and nearly quadrangular.

Before dealing with the detentive surface, the unique histological relation in *S. purpurea* claims attention. In this species the conducting zone is comparatively narrow (1—2 cm wide, Fig. 5 *Bb*) and along its lower margin its nearly straight-walled epidermal cells gradually assume a wavy or zigzag aspect (*Cf*), that is continued downward to a considerable depth. Glands become more abundant over this than over the conducting region, and Hooker has therefore appropriately termed it the "glandular" zone. Its depth is five to eight times greater than that of the zone above. It evidently represents a specialized condition in the upper part of the detentive surface of *S. minor*, in that the detentive hairs have been absorbed, though the epidermal cells retain the same zigzag outline and the glands persist. Such a conclusion is strengthened by study of hybrids between *S. purpurea* and other species.

The detentive surface is distinguished histologically by the long tapered thick-walled hairs that are attached by narrowed base to some of the epidermal cells. These effectually prevent return or ascent of the animals that have dropped from above. But this more evident relation may incline one at first sight to overlook other peculiarities. Thus in *S. minor* and *S. psittacina* the epidermal cells of the upper region are wavy in their walls, lower down they become straight-walled. Glands are also abundant in these over the upper half. In *S. psittacina* and *S. Drummondii* stomata are fairly common over the same area, though not found higher up in the tube. In *S. purpurea*

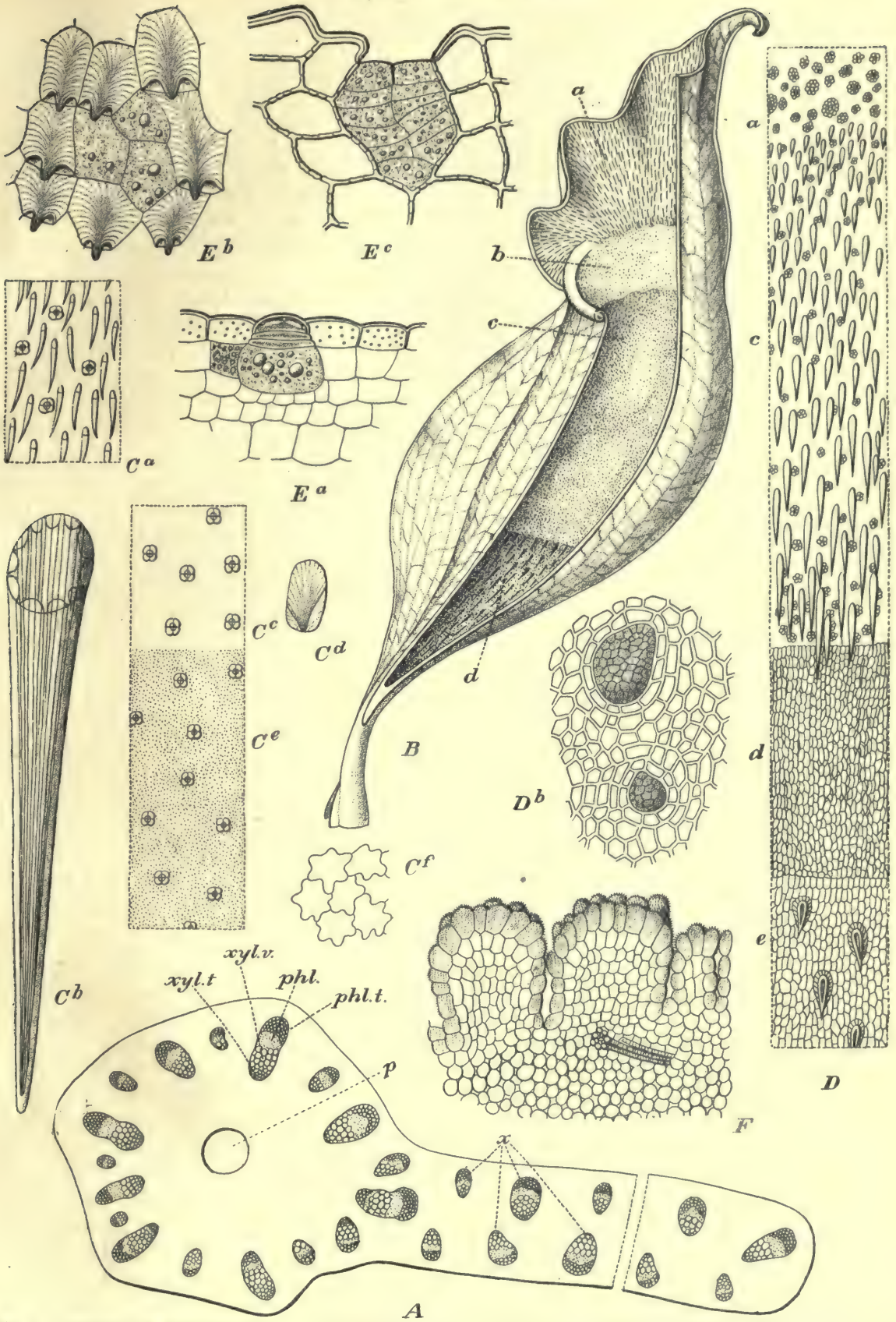

Fig. 5. Histology of *Sarraceniaceae*. *A* Transverse sect. of pitchered leaf of *Sarracenia flava* slightly above level of pitcher bottom, fibro-vascular system alone shown, *p* pitcher cavity. — *B* Leaf of *S. purpurea* cut open. *a* "attractive" lid surface, *b* smooth "conducting" surface, *c* glistening "glandular" surface, *d* "detentive" surface. — *C* Magnified views of last, *a* "attractive" surface with glands and hairs, *b* hair magn., *c* "conducting" surface with glands, *d* epidermal cell from *c* magn., *e* "glandular" surface, *f* a few cells from *e*. — *D* Epidermis from pitcher cavity of *Heliamphora*, *a* lid surface with "attractive" glands, *b* two glands magn., *c* "conducting" surface, *d* smooth zone, *e* "detentive" surface. — *E* Glands of *Darlingtonia*, *a* section of "alluring" gland from pitcher exterior, *b* "attractive" gland from inner pitcher-rim, *c* sectional view of *b*. — *F* Nectariferous papillae from outer ovarian wall of *S. purpurea*. (Original.)

transition from the "glandular" to the "detentive" surface is very sharp, the wavy cells and abundant glands of the former suddenly changing into the straight thick-walled cells devoid of glands in the latter. Though the transition is a gradual one in *S. minor*, the writer considers that the upper half of its detentive surface is distinct from the lower, and that the glandular area of *S. purpurea* is a modification from the former. Striking confirmation of this view is got from study of hybrids between *S. purpurea* and *S. flava*. Thus natural specimens of this hybrid, first described as *S. Catesbaei*, as well as artificial hybrids of the same parentage, show a blending of wall outline, glands and hairs in the glandular zone, and a rather sudden transition to the straight-walled cells of the detentive zone.

The lowest part of the pitcher cavity, to the depth of 2—4 cm, is usually devoid of hairs, as pointed out by Goebel, but the epidermal cells otherwise exactly agree with those of the typical detentive surface. The presence of hairs here would be superfluous. There seems no good reason either for regarding it as a special absorptive zone, so that the application of a particular name to it seems scarcely necessary.

The surface histology of laminar phyllodia does not differ from that of the lower external areas of pitchered leaves. But the scale or autumnal leaves deserve some notice. In these numerous glands occur alike over upper (inner) and lower (outer) surface. Stomata are absent over the upper epidermal surface in all the species, they are sparingly present over the lower (outer) epidermis in *S. purpurea*, but are absent in most. Such anatomical details favor the view that scale leaves are merely greatly reduced pitchered leaves.

The internal histology of the leaf is instructive, owing to the peculiar laminar modifications that have developed. The petiolar sheath shows an irregular crescent of vascular bundles that have run out from the rhizome. They exhibit typical collateral structure, have strong stereom patches without and within, and are embedded in a loose starch-storing cellular tissue that is surrounded by the epidermis. Higher up in the cylindrical part of the petiole, the bundles orient themselves so as to form a discontinuous circle of bundles on the inner side of the chlorophylloid cortex, and an irregularly disposed central series. Though varying in size all retain similar structure, except that the stereom patches become stronger and more prominent. At the level where the laminar wing begins to protrude two sets of bundles run out into it, and these are so disposed that their xylem-patches face each other, while their phloem-patches face toward the exterior. Slightly higher up the midrib bundles arrange themselves into a loose ring, while the cellular tissue that they enclose becomes hollowed out by the invaginated epidermal tissue that lines the pitcher cavity. With increase in width upward of the laminar wing additional double sets of vascular bundles pass into it from the now hollowed-out midrib. Those which have already entered may also branch lengthwise. A structural condition is thus developed that is shown in Fig. 5 *A*. The chlorophylloid tissue is mainly massed beneath the outer epidermis, the subjacent cellular tissue is highly spongy, and its cells store starch. Next to the epidermis of the pitcher cavity are 3 to 4 layers of transversely elongated rather thick-walled cells of relatively large size. These contrast strongly with the small epidermal cells, each of which while it may be thickened along its lateral walls, shows a thin delicate wall against the pitcher cavity over the lower detentive area. A peculiar structural modification of the upper part of the pitcher is seen in *S. minor*, *S. Drummondii*, and less sharply in *S. psittacina*. Toward the top of the pitcher occur clear white circular areas, similar to those of *Darlingtonia*. In *S. minor* these are mainly confined to the posterior part of the orifice and base of the lid. In the two remaining species they are formed abundantly round the orifice and on the lid or hood. Each area consists of external and internal epidermis that are almost apposed owing to thinning-out of the mesophyll. External and internal hairs and glands are absent over each area, but round it the hairs are so disposed that each is a fenced enclosure open only on one side, for while the lower and upper hairs are directed longitudinally, the lateral ones point obliquely towards

the area. Such areas may therefore be viewed as temporary resting places for smaller insects, that allow them time to overcome the fear excited through the impediment offered by the hairs to their feet.

In *Darlingtonia* the external epidermal surface is covered with alluring glands as in *Sarracenia*. But each is one-celled on surface view, and four- to five-celled in section (Fig. 5 *E*a). The lowest cell of the series is largest and goblet-shaped. These glands become greatly more abundant and complex round the involute edge of the mouth, as shown in Fig. 5 *Eb*, *Ec*. Each consists of 4 to 5 times the number of surface cells, and these are surrounded by striated overhanging neighbor cells that are often of a brilliant crimson color. The inner surface of the involute edge is smooth to the depth of 5—6 mm and devoid of glands. Below this is a narrow band of long stiff outstanding hairs, that are different from all others of the cavity. The inner surface of the bilobed process in front of the mouth secretes honey copiously from many glands, and amongst these glands are short strong hairs that are all directed upward toward the mouth. The hood of the pitcher likewise functions with the bilobed process as an attractive surface, and has many long strong downwardly directed hairs, intermixed with glands that are 1—2-celled on surface view. The conducting surface has the same structure and relation as in *Sarracenia*, and it gradually merges into the detentive surface that bears long delicate hairs.

Biological Relations of the Leaves (Blattbiologische Verhältnisse). The striking biological peculiarities shown by the leaves of the *Sarraceniaceae* early attracted the attention of botanists. Lobel in 1570, Clusius in 1601, and Johnson — in Gerard's Herbal — in 1633, all refer to, and in some cases figure the leaves of *S. purpurea* and *S. flava*, while plants were grown at South Lambeth, London, during the last-named period by John Tradescant Jr. who had brought them from Virginia. Good descriptions and illustrations are given by Plukenet of the two species above named (Phytogr. 1691, t. 152, fig. 3; 376, figs 5, 6). But Miller in 1739 (Gard. Dict. 3rd ed. II.) mentioned the presence of water in the tubes, only to suppose that they were intended to quench the thirst of birds etc. during long droughts. Even Catesby who must often have wandered amongst wide areas of them, could only suppose that the pitchers served "as an asylum or secure retreat for numerous insects, from frogs and other animals which feed on them". While W. Bartram and Robin seem both to have interpreted their meaning correctly, Macbride first gave a very careful account of the structure of the pitcher of *S. minor*, and its capacity for catching insects. Subsequent observers confirmed or denied this, till Mellichamp established, on a firm basis, the insectivorous character of the group, through painstaking observations in the field on *S. minor*, and to a less degree on *S. flava*. Hooker extended these studies to other forms in his address before the British Association in 1874. Many subsequent observers have greatly amplified our knowledge of the group.

In their native haunts these plants develop their pitchered leaves in April and May along with the flowers (Fig. 10) or more commonly soon after the flowers have blossomed. During May and June the alluring glands over their surfaces begin to exude nectar drops, which are highly attractive to insects. In *S. flava*, and to a less extent in *S. Sledgei* and *S. Drummondii*, with their rib-like longitudinal veins, the surfaces of the veins may be thickly studded by large nectar drops, while in early June the entire outer pitcher surface below the mouth may glisten with an almost continuous secretion. Tempted upward by this over the exterior of the pitcher, or alluring surface, they in some cases reach the orifice directly, or may first move up to the lid in *Heliamphora* and *Sarracenia*, or to the bilobed flap in *Darlingtonia*. The secretion along the outer margin of the lid in *Sarracenia* — specially in *S. flava* and *S. Sledgei* — or along the orifice in *S. psittacina* and *Darlingtonia*, is abundant and sweet. They thus incline to step on to the inner surface of the lid, that forms the attractive surface, or they may at once step inside the tube, on to the conducting surface. When an insect has reached the latter it at once begins to show peculiar

and uncertain movements. At times, after a few unsteady and wavering steps, it drops deeper into the pitcher; at times by special effort aided by wing action it may ascend somewhat, but very often after repeated trials the animal is landed below on the detentive surface, where the narrowness of the tube and the long hairs alike prevent subsequent ascent.

The varieties and numbers of insects caught, vary in different areas and under different conditions. In one locality of New Jersey near Island Heights, the writer found during one summer that *S. purpurea* mainly caught grey crickets, so that many of the pitchers were filled in their lowest third with these. But *Sarracenia*, in most of the Central and Southern States, also *Darlingtonia* as brought to me by Dr. Krautter from N. California, alike catch most varied prey. This probably represents the average nectar-sipping insects that are common to each locality. Occasionally slugs, spiders and the caterpillars of insects are caught. But the writer had a peculiar experience with a lot of plants of *S. flava*, that he gathered round Wilmington N. C., and which were planted near a pond in the Botanic Garden of the University of Pennsylvania. In the succeeding June and July an enormous number of moths was caught. These were tempted to enter in part doubtless by the nectar, but probably more by the desire to find in the pitchers a safe hiding-place during day. The long pitchers became filled to within 5—8 cm of the mouth with the caught prey. These decayed amid the scant rain water of the summer, and the strong ammoniacal products soon caused the pitchers to rot, and most of the plants to decay. It is significant — though difficult of explanation — that in the wild state such abundant captures do not seem to be made, though F. M. Jones records the frequent capture of several moth species. In 1891 the writer wrote (A. of B. VII. 413) "Sir J. Hooker suggests that it is probably ground game which is led up to the pitchers, and while this may be true to some extent, in our greenhouses flying insects almost entirely are caught, and these consist in about 18 cases out of 20 of bluebottle flies, with an occasional earwig, wasp or housefly. These alight on some part of the tube, and gradually crawl up to the pitcher mouth, sipping the honied juice as they go". In a foot-note to the above was subsequently added "since writing the above I have had the opportunity of examining *S. purpurea* in the New Jersey swamps, and find that ground-game, notably ants, are largely caught by the pitchers. Flying insects and slugs are not uncommon, and though bulk for bulk they may yield a considerable food supply for the plants, Hooker's supposition appears correct for this species. In one specimen examined a large nest of ants had been established in three of the older and rather dry brown leaves, just beneath the reddish-green leaves that were actively catching prey". From greatly more extended observations, the writer's original conclusion is still retained, namely that winged insects are caught in preponderatingly large measure. A correspondent of Mellichamp stated that *S. psittacina* caught ants chiefly, and this with the above statements of the writer might suggest that the decumbent species (*S. psittacina* and *S. purpurea*) chiefly catch small running insects, while the upright species capture winged prey.

In view of the diverse and conflicting opinions at present held regarding the value of plant colors for the attraction of insects, it is probably superfluous to discuss the relation of these in the *Sarraceniaceae* to the prey that they catch. It is however undoubtedly true that plants growing in bright sunshine and of a rich color, are more abundantly visited than are others that grow in shade and are green. As stated below Edwards considers this to be true also for *Darlingtonia*. The average capacity for catching animal prey seems to vary considerably. At the top of the list should be placed *S. flava*, *S. Sledgei* and *S. Drummondii*, next *S. minor* and *S. purpurea*, while *S. psittacina* and *S. rubra* are relatively poor. The pitchers of *Darlingtonia* — at times like those of *S. flava* and *S. Drummondii* 1 m high — often catch abundant prey. From study of the plant in its native haunts Edwards found 43 species of insects in the tubes, belonging to seven different groups, of which at least 20 were Diptera. He considered that the green tubes captured fewer insects than those that were richly colored.

The securing of such rich nutritive supplies must be of value to these plants, if such supplies can be properly and judiciously utilized. But the conclusion reached by many writers that the absorbent root system is not sufficiently vigorous or wide spread to enable them to obtain a sufficient supply from the soil, seems scarcely justified from a careful study of that system. The added contention however, that the soil around is relatively poor in available nitrogenous compounds is probably correct. All of the species flourish only when growing in a fine black but somewhat sandy silt. A fibrous or coarse soil is eminently unsuitable. But apart altogether from the capacity to absorb animal matter through the pitcher wall, or crude sap through the fine rootlets, a certain advantage must undoubtedly be gained for the plant, by the decay of the older pitchers in which the remains of the insects still are. In this manner the roots will secure a slight remaining amount of what the leaves may have failed to absorb, a view that has been suggested by several writers.

Before the pitchers open (Fig. 10 *b'*), and while they are hermetically sealed even against passage of air, a slight amount of rather thick viscous clear liquid is found in the bottoms of the pitchers, specially of *S. flava* and *S. Drummondii*. This can be seen to exude, in part from the pitcher wall, in part from the more deeply placed glands when such are present, as in *S. minor*. After the pitchers have opened this liquid may be added to by the entrance of rain water, except in *S. minor*, and to a less degree in *S. psittacina*. The nature and action of this secretion have been variously interpreted. While the liquid that appears as fine droplets on the lid, on the margin of the orifice, and even over the upper part of the conducting surface, is sweet to the taste, that excreted from glands on the lower conducting surface, on the glandular surface in *S. purpurea*, and on the detentive surface in *S. minor* and *S. psittacina* is tasteless. Mellichamp showed that it is mucilaginous and astringent, also that it hastens decomposition, though he failed to trace any digestive action. Hooker and most succeeding observers accepted Mellichamp's position. The experiments of Gies are too fragmentary, and were only made on the macerated pitcher substance, which might well contain several intrinsic ferments, none of which may normally be excreted. Recently Fenner has stated, from observations which are by no means conclusive that "*Sarracenia flava* ist als Insektivor mit verdauendem Enzym zu betrachten". Experiments have yet to be undertaken for the genus, in as careful a manner as for *Nepenthes* by Clautriau and Vines, before a final decision can be reached. No ferment substance has been traced in the pitchers of *Darlingtonia*, and Edwards considered that decomposition alone took place.

In striking contrast to the relation of other insects is the behavior to *Sarracenia* of certain species found along the Eastern States, as also of a species in California to *Darlingtonia*. Mellichamp observed and carefully traced the presence, in the tubes of *S. minor*, of a larva that was later studied and identified by Riley as *Xanthoptera* (*Exyra*) *semicrocea*. The adult insects deposit eggs in the tubes, and on hatching the striped brown and white larva in each spins a fine web across the mouth or some deeper part of the tube, so as to seal it up. As the larva grows it greedily gnaws away the internal epidermis and the mesophyll tissue, and leaves only the external discolored epidermis in irregular patches. The larval excrement forms brown pellets among the decaying insects in the bottom of the pitcher, and near these, on one side of the wall, an oval cocoon is spun, inside which the chrysalis moults into a small moth that in time emerges from the tube. This insect frequents *S. Sledgei*, *S. minor* and *S. flava* most abundantly, and in frequency according to the order given. It may also inhabit *S. Drummondii*, but is rarest in *S. purpurea* and *S. psittacina*. It often destroys all or most of the pitchers in the three species first named, to such an extent that it is difficult in some localities to find good herbarium specimens. Such was the writer's experience recently in Mississippi. According to F. M. Jones two other moths, related to the last, *Exyra Ridingsii* and *E. Rolandiana* inhabit the pitchers of *S. flava* and *S. purpurea* respectively. They show similar habits to the above.

A dipterous species found in *Sarracenia* according to Riley is *Sarcophaga sarraceniae* which, with a beetle *Euphoria* (not *Euryomia*) *melancholica*, also shelters in the flowers. The parent fly drops a dozen or more of her living larvae into a tube, and these feed on the softer parts of captured flies. As a rule one survives at the expense of the others that fall a prey to its gluttony. When mature the caterpillar eats through the tube, burrows in the ground, and in time hatches. The writer has found *S. Sledgei* to be badly infested by both insects, *S. minor* and *S. flava* are so to a less degree. Their combined injurious attacks must have a destructive effect on the species first named, and this possibly explains in part its localized distribution.

In the New England States the only "Pitcher-plant Moth" is *Exyra Rolandiana*. Its larvae may be noted in the old pitchers of *S. purpurea* soon after the spring snows have melted. They start to eat the leaf, may then move to others, and usually spin a sealing web across each. Thaxter considered that the long frenulum at the base of the wings gives this species its ability to crawl up the leaf. Allied to it is *Papaipema appassionata* of the same region, which however attacks and hollows out the rhizomes. It seems less unlikely to find *Sarracenia* pitchers utilized as breeding places for mosquitoes. J. B. Smith has shown this to be true (Entomol. News XII [1901] 153, 189) for *Aedes fuscus* and *A. sapphirinus*, the larvae of which may survive through Winter, even though frozen in the water of the pitchers of *S. purpurea*.

The pitchers of *Darlingtonia* always contain, according to Edwards, the living larvae of a small, almost microscopic dipterous insect, whose complete history has not been determined. He also observed that a small spider, probably allied to *Thomiscus*, spun its web across the pitcher mouth, as if knowingly selecting a favorable field for its own operations.

Floral Structure and Pollination (Blütenverhältnisse und Bestäubungseinrichtungen). With the exception of the primitive monotypic genus *Heliamphora*, the flowers in *Sarraceniaceae* are solitary and each is borne on the extremity of a long peduncle. In the former three to six flowers develop in racemose manner along the upper part of the inclined peduncle (Fig. 2). The flower buds form in August and September of the previous season, but remain concealed amongst the leaf bases till March or April. During the former period the microspore mother-cells and the megasporangial rudiments arise, but both rest during the winter in that state. The flower-stalks in nearly all cases elongate, and the flowers bloom in Spring, before the leaves of the same season have elongated. When the flower-stalks of *Sarracenia* and *Darlingtonia* start to grow in Spring, they are straight and end in upright buds, but when the stalk is fully half grown its extremity begins to bend by geotropic reaction, and within a day or two the flowers have become inclined. The inverted position is retained throughout the blooming period, and is a necessary one for pollination in *Sarracenia*. But in such species as *S. flava* the flower-stalk gradually straightens out two to eight days after pollination, so that each flower with its maturing fruit is vertical or even erect. The green expanded peltate styles then form the conspicuous objects to which the popular name "watches" has been given in the Southern States.

The bracts and sepals of *Heliamphora* are ovate, and are abundantly supplied with honey glands that may differ in their cellular complexity. These glands are here accessory to flower-pollination. The same type of gland therefore, and the same kind of secretion, lure insects to their destruction over the foliage leaves, and attract them in order to ensure flower-pollination over the floral leaves.

The flower-stalk in *Darlingtonia* (Fig. 9) is beset by scattered linear-lanceolate bracts of a pale yellow-green color. Histologically these are abundantly covered on the lower, and more sparingly on the upper surface with glands. From each epidermal cell on the upper surface, and in the higher bracts on the lower surface also, springs a tubercular swelling of unknown functon. The sepals are lanceolate, of a richer yellow hue than the upper bracts, are traversed by 11—13 veins, have a few stomata, but are devoid of or rarely show nectar glands.

Each flower in *Sarracenia* is subtended by three strongly convex bracts arranged in spiral order, and which vary in color from green to yellow and crimson. They are closely adpressed to the calyx, and have abundant honey glands over their outer surface. The five sepals are disposed in $^2/_5$ spiral order. They vary from green to yellow or crimson in whole or in part. They are always unequal in size and of varying consistency. The outermost sepal is broader, shorter and thicker than that next in spiral order, the innermost is longest, narrowest and most delicate in consistence. Their surface is covered to a varying degree with nectar glands that secrete a fair amount of nectar during and even after the flowering period.

The petals in *Darlingtonia* are of a reddish-yellow color, are traversed by 11—13 reddish-crimson veins, and each is deeply constricted about $^1/_3$—$^1/_4$ from its apex. The cells of this upper constricted part are covered with fine papillae, that probably aid insects in their movements over the flowers. The petals in *Sarracenia* are modified in shape and consistence at different levels, to adapt them to their role of aiding cross-pollination. As shown in Figure 6 *A* each consists of a basal and a terminal segment. The basal segment from its point of insertion gradually widens out into a triangular plate, it then becomes narrowed and has the margins slightly (*S. psittacina*) to deeply (*S. Drummondii*) reflexed. This entire basal segment grows outward over the margin of the style-umbrella as a firm expanse, and then widens into the terminal segment that forms the large flaccid depending part of the petal. The external surface of this segment has papillose epidermal cells, while over the inner surface a few honey glands occur in some of the species.

The stamens vary from 10—∞, and are inserted beneath the ovary. According to Shreve they arise in *Sarracenia* as ten groups of primordia. The development of the

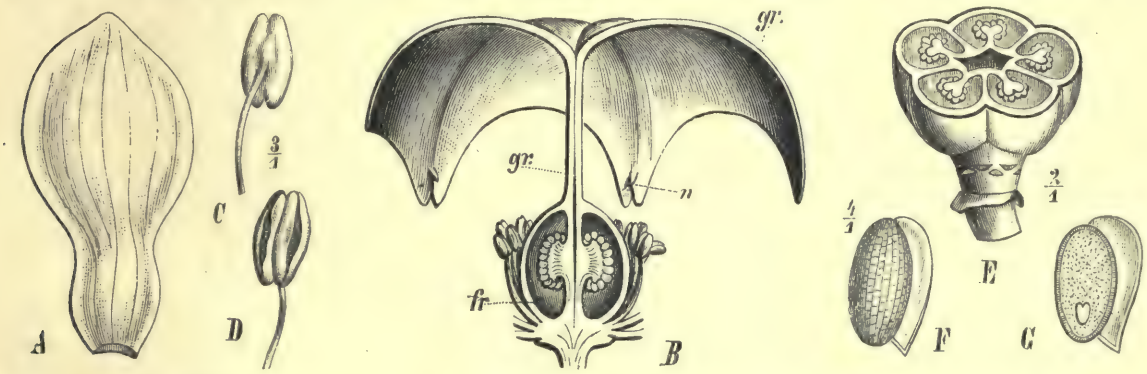

Fig. 6. *Sarracenia purpurea* L. *A* Petal. *B* Vertical section of the flower, sepals and petals cut away; *fr* ovary, *gr* style, *n* stigma. *C* Anther, from the outside. *D* Anther, from within. *E* Transverse section of the ovary. *F* Seed. *G* Vertical sect. of the seed. (Cop. from Engler-Prantl, Pflzfam. III. 2, p. 249, fig. 149.)

four microsporangia in this genus, follows also the normal course for Dicotyledons, and the microspores when ripe show a tube nucleus and a generative nucleus. In the youngest flowers of *Darlingtonia* yet studied by the writer, the stamens were typically 15 and formed a close circle round the still small pistil. The pollen grains are polyhedral in end view, and ovoid in longitudinal view in all three genera. Relatively a large amount of pollen is matured from one *Sarracenia* flower. This either falls, by its own weight, in rich showers into the umbrelloid style cavity, or often it is washed down and agglutinated by drops of nectar that exude from the nectariferous ovarian wall. This relation of the ovarian nectar to the pollen seems important, as giving the latter an adhesive quality, that not only enables it to adhere to the bodies of insects, but equally to the minute stigmas that always seem to be dry in themselves.

The pistil consists of 5 (*Darlingtonia* and *Sarracenia*) or of 3 (*Heliamphora*) united carpels, that grow inward to form a 5—3-celled ovary. The numerous anatropous ovules in *Sarracenia* are arranged in five longitudinal rows along the thickened

recurved placental margins (Fig. 6 *E*). Each ovule undergoes typical angiospermic development, up to the time of pollination. In *Heliamphora* the conical ovarian wall (Fig. 2 *D*) is covered with bifurcated hairs and with honey glands, like those of the pitcher exterior. In *Sarracenia* as above noted, the entire ovarian surface is covered with multicellular tubercular crystalline swellings (Fig. 5 *F*) that begin to exude nectar as the flower opens. The excretion may go on more or less interruptedly, if pollination is not effected, for 10—20 days, by which time the petals and stamens will have fallen. But it may even exude for 5—8 days after the deciduous flower parts have fallen. The style is a cylindrical pillar in its lower part, that is traversed centrally by a canal, down which the pollen tubes pass. Higher up it expands greatly in umbrelloid fashion to form a large cavity, which, from the inclined position of the flower, receives the abundant pollen that falls from the stamens above (Fig 6 *B*). Its outer surfaces may be more or less hair-covered, and abundantly provided with stomata. The latter structural detail is in keeping with the green persistent condition shown in the fruiting state. The small projecting stigmatic knobs (Fig. 6 *B n*) bear abundant but minute stigmatic hairs, and from the stigmas loose conducting cells pass into the style veins.

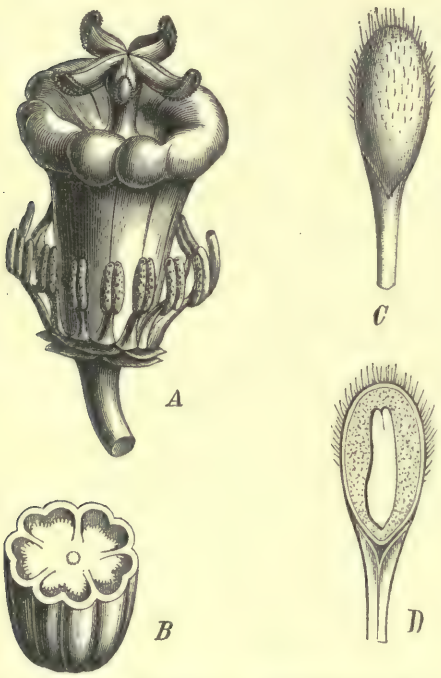

Fig. 7. *Darlingtonia californica* Torr. *A* Flower, sepals and petals cut away, twice magnif. *B* Transverse section of the ovary. *C* Seed. *D* Vertical section of the same. (Cop. from Engler-Prantl, Pflzfam. III. 2, p. 252 fig. 152.)

In *Darlingtonia* the turbinate ovary of the pistil (Fig. 7 *A*) is closely covered with shallow crystalline tubercles, that histologically resemble those of *Sarracenia*. These exude a moderate amount of nectar. The short style that springs from the centre of the depressed apex of the ovary ends in 5 horizontal slightly grooved style arms, whose sides and extremities are covered with elongated tapered and overlapping stigmatic cells. The three genera therefore of this group secrete floral nectar either by glands like those of the sepals and vegetative leaves (*Heliamphora*), or by special tubercular ovarian glands.

Torrey and De Candolle have drawn attention to the relation of the carpels to the stamens and sepals. In *Sarracenia* the carpels are opposite the sepals, and if as stated above the stamens arise as ten primordia, such would be the normal relation in the successive whorls. Faxon delineated for Torrey the carpels of *Darlingtonia* as being alternate with the sepals, and this would seem to be their true relation, for if the typically 15 stamens arise as distinct primordia, such would be the normal succession. Study of the floral embryology will alone settle the point satisfactorily.

Detailed information is still lacking as to the pollination of *Heliamphora*, but from the floral structure this is probably effected in a simple manner by insects that are attracted by the nectar of the sepals and ovarian wall. In *Darlingtonia* the flowers seem to be proterandrous, and the pollen from the relatively short stamens is matured as the flower opens. Attracted by the ovarian nectar, insects receive the pollen and carry it to older blooms, in which the radial style arms are now fully divaricate and ripe for its reception. Anthers examined in this later stage, at times show a few starved or empty pollen shells, but few if any that are good. The pollination of *Sarracenia* is the most complicated, and has been described by Hildebrand, Masters and the writer. When the blooms begin to unfold, an odor is given off that varies with the species. *S. flava*, *S. Sledgei* and *S. minor* exhale this most powerfully toward evening, as might have been expected from the color of the flowers. The odor

of *S. minor* suggests a faint lemon scent, that of *S. Sledgei* resembles a fine lemon-violet combination, that of *S. flava* is very powerful in the evening and suggests the odor of Turkey Rhubarb. During the flowering period in April, the writer has observed a considerable variety of insects in the umbrelloid style cavities of *S. flava*. But bees during day abundantly search out the flowers, and effect pollination extensively. The remaining four species, that have more or less crimson flowers, exhale an agreeable odor suggestive of violets. The most strongly scented is *S. rubra*, that almost rivals sweet violets in intensity. Small bees are usual visitors to it.

The anthers begin to dehisce as the flowers are opening. The pollen in dry state, or mixed with nectar, gets abundantly scattered within two days at most over the umbrelloid style-floor. The blooms usually remain fresh for 12—19 days, if not visited earlier by insects. A bee alighting on the honied sepals, or on the depending petals, moves up to the space between two adjacent petals. To do this readily it must step first on one of the projecting arms of the umbrella (Fig. 8), and guided by the hairs often present there, it must creep round the tip of the style arm, at or near the stigmatic knob, so as in many cases to touch it. A bee that has already visited a flower, thus brings nectar-soaked pollen to the stigmatic knob. Then passing into the umbrelloid cavity it again revels amid the nectar-pollen, and becomes again smeared. But in leaving the flower, it most readily escapes by slightly lifting an incurved petal along one side, at the junction of the basal and terminal segments. Cross pollination in this genus seems to be essential, since thousands of blooms matured in the *Sarracenia* house of the Botanic Garden at the University of Pennsylvania, have never set seed, while others that were cross-pollinated in the same species or between different species, never failed to mature abundant and good seeds.

Hybridization (Bastardbildung.) The genus *Sarracenia* is of exceptional interest from the standpoint of hybridization. Under cultivation many hybrids have been secured, since Dr. Moore of Glasnevin exhibited the first artificial hybrid at Florence in 1874, up to the present day, when the market is stocked with them. In 1888—89 the writer made a histological study of some of these (Annals of Botany VII. [1893] 447), and since that time he has had many opportunities for studying the plants in their native haunts. The first natural hybrids observed by him were two plants of *S. flava* crossed by *S. purpurea*, gathered near the Shell-road, Wilmington N. C. in 1894. Both grew in close proximity to each other and to the parent species, and resembled the artificial hybrid of like parentage cultivated as *S. Stevensii*. Round Ponce de Leon, Fl[a]. in 1905 he observed 117 plants of the same hybrid during one day's botanizing. A recent opportunity for study of the specimen from Charleston Museum, that was described by Elliott as *S. Catesbaei*, clearly proved it to have been the same hybrid. From an investigation of the locality where Macbride obtained it, the writer can well believe that it may be common throughout the Chesterfield region of S. Carolina. In 1903 he gathered plants of *S. flava* × *S. minor* near Summerville S. C., and the same hybrid is recorded by Harper from Bulloch and Coffee Counties, G[a]. Harper also collected considerable material of *S. Drummondii* × *S. flava* (or doubtfully *S. rubra*) in Georgia (Bull. Torr. Bot. Club XXX. [1903] 334). He supposed these might be Elliott's *S. Catesbaei*, and as such he in part distributed

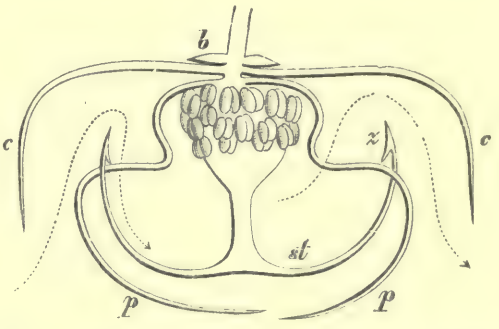

Fig. 8. *Sarracenia purpurea* L. Schematic section of the flower, in order to show the fertilization by insects; *b* bracts, *c* sepals, *p* petals, *st* expanded part of the style, *z* stigmatic knob. — The dotted lines indicate the path of an insect through the flower. (Cop. from Engler-Prantl, Pflzfam. III. 2, p. 250 fig. 150.)

sheets to herbaria. In 1905 the writer saw abundance of this hybrid (already named *S. Mandaiana*), along with its parents near Bay Minette, Ala., and he then secured a few hybrids of *S. Drummondii* with *S. purpurea*, as well as the hybrid first treated of above. He has also received from S. E. Georgia a hybrid between *S. minor* and *S. psittacina*, and Harper has recorded this from four counties in Georgia. Curiously enough, though the writer has explored many miles of territory in which *S. purpurea* and *S. psittacina* grew side by side in great abundance, he has failed to note even one example of the hybrid. But this is already well known in cultivation as *S. Courtii*, and has originated in at least three botanical establishments. Finally at Ponce de Leon a plant was obtained that in pitcher and floral structure proved to be *S. flava* × *S. purpurea*, and recrossed by *S. flava*. The pitchers greatly resembled those of *S. flava* but in color and shape the flowers showed marked traces of the other parent.

Fruit and Seed (Frucht und Samen). The maturing capsules, in all species of the group, are surrounded by the persistent sepals and by the bracts, where these are close to the flower. At first inverted the capsules may remain so, as in *S. psittacina*, *S. Sledgei*, etc., or they may become transverse or nearly upright as in *S. flava*, or quite erect as in *Darlingtonia*. Capsular dehiscence is loculicidal. The yellow glistening capsule of *Heliamphora* when ripe, breaks apart from above downward into three segments, to one of which the persistent thread-like style adheres. The dehiscence is similar for the five yellow segments of *Darlingtonia*. In *Sarracenia* the five yellow-brown or brown segments of the almost spherical capsule, remain adherent by the common axial substance that is prolonged into the persistent style base, and dehisce longitudinally along their external or dorsal sutures. The period for maturation of the capsule of *Sarracenia* is four to five months. The nectariferous tubercles of the ovarian wall are faintly observable in the mature fruit of *Darlingtonia*, but are conspicuous in *Sarracenia*. In *S. flava* and *S. Sledgei* they form deep irregular knob-like plates, in *S. purpurea* isolated papillae, in the other species irregular tubercles of varying size.

The seeds of *Heliamphora* (Fig. 2 *F*) and *Darlingtonia* (Fig. 7 *C, D*) show a suggestive approach to those of *Nepenthes* in position and structure, since the testa is expanded into a membranous wing in the former, and into an attenuate caudate process, whose surface is covered by blunt unicellular hairs, in the latter. The grey-yellow or flesh colored testa in *Sarracenia* is warted and ridged (Fig. 6 *F*). It consists of a columnar layer of indurated cells with pore canals, and whose walls are here and there elevated into tubercular swellings. The cavities are filled with a dense oily substance. A second layer of transversely elongated cells with thickened outer walls but thin lateral and internal walls, contains also dense oily contents. Succeeding these are 2—3 thin flattened layers of tegmen that surround the endospermic albumen. The albumen cells are rounded and filled with oil and angular protein grains. The small embryo has a short radicle, two elongated cotyledons, and a minute plumule. On germination the radicle first protrudes and lengthens, the linear cotyledons next elongate, become green, and appear outside the seed. Their tips remain colorless for a considerable time and absorb the albumen. As they elongate the seed coat is pushed upward, one of the cotyledons next disengages itself, and the seed coat remains hoisted on the tip of one cotyledon for a short time. Subsequent changes have already been described.

Geographical Distribution (Geographische Verbreitung). The genus *Heliamphora* is only known to occur round and on the precipitous Mount Roraima between British Guiana and Venezuela. First encountered by the brothers Schomburgk, and stated by Richard S. (Reisen in Brit. Guiana III. [1848] 1090) to occur "am südlichen Abhange des Roraima in einer Meereshöhe von 6000′", it was afterwards collected and introduced into cultivation by Burke. More recently it has been traced from the base to the mountain summit by E. Im Thurn, who says that "it grows in wide spreading very dense tufts in the very wettest places, but where the grass happens

not to be long. Its red-veined pitcher-leaves, its delicate white flowers raised high on red-tinted stems, its sturdy habit of growth, make it a pretty picture wherever it grows. But it attains its full size and best development not down here in this swamp, but upon the ledges on the cliff of Roraima, and even on the top". In all details of structure it shows marked affinities with *Sarracenia* and *Darlingtonia* on one hand, and with *Nepenthes* on the other. From the geological conformation of the extensive surrounding territory and our slight knowledge of it, the plant may yet be found on some of the "Eppellings" or abrupt mountains between Roraima and the Rio Negro.

Darlingtonia californica extends from Plumas County, in the Sierras of California, northward for 350 km into Josephine and Jackson counties, Oregon. But its most abundant centre, according to Howell, is in the coastal mountains round the 42nd degree of latitude in Northern California and S. W. Oregon, where it may grow at an elevation of 1250—1800 m.

Sarracenia is wholly confined to the Eastern States of North America, except *S. purpurea* that is of wider range. Accepting it that the genus was distributed from the eastern Gulf State region, the most primitive species *S. minor* extends from Mid Florida northward over the low flat sandy pine lands of Georgia into S. Carolina and the borders of N. Carolina. *S. Sledgei* has been traced by the writer from the low alluvial lands of S. E. Texas across Louisiana, Mississippi and Alabama to the Alabama river. It extends inland for at least 200 km in Alabama according to Harper. *S. Drummondii* and *S. psittacina* are confined to a nearly circular area that extends from Alabama to N. W. Florida and Georgia. In the latter state they pass inland for about 170—200 km. *S. flava* and *S. rubra* extend from the Alabama river and Gulf Coast eastward to N. Florida, and northward along the Carolina coast to the southern part of Virginia. *S. rubra* ascends among the N. Carolina mountains to about 700 m. *S. purpurea* has an extensive range that is equalled by few N. American plants. Common from Louisiana eastward to north-central Florida, it stretches northward east of the Appalachian range for 3500 km to Labrador and Newfoundland. North of the Alleghanies it extends its western range for about 3000 km to W. Minnesota and W. Central Canada. Its flowering period in Florida is the first week in April, round Wilmington N. C. the third week in April, in New Jersey the third week in May, in northern N. York and Minnesota the third week in June, in Maine the second week in July, in Newfoundland the first and in Labrador the second week in August.

The above distribution of the group would suggest that the focus of origin was located in the eastern Gulf State region, or in N. E. South America, and that originally widely distributed over the North American continent the species have now become segregated into species-areas, of which the most extensive is that now occupied by *S. purpurea.*

Systematic Relations (Verwandtschaftliche Beziehungen). Breyn described the two species of *Sarracenia* known in his day under the generic name *Nepenthes*, that included also the eastern pitcher-plants. Such classification may have been founded on rather loose morphological grounds, but marked a great advance on the views of his predecessors. Most botanists, since the time of Linnaeus, have placed this group near the *Papaveraceae* and *Nymphaeaceae.* The supposed structural relation of the leaves to peltate leaves of some *Nymphaeaceae* is, we believe, a mistaken one. Engler first clearly pointed out the close affinity of *Sarraceniaceae* and *Nepenthaceae.* This was further emphasized by the writer, who inclines to unite the two into a single alliance made up of four genera. The points of exact morphological agreement are many, the differences are few, and are in part bridged over by the genus *Heliamphora.* The *Sarraceniaceae* and *Nepenthaceae* should therefore be regarded as of closest affinity. Little importance need be attached to the physiological relations of the leaves in *Sarraceniaceae* and *Droseraceae*, but apart from such the floral morphology of the two orders would bring them near each other. All of these orders show

important characters in common with the *Papaveraceae* and *Nymphaeaceae*, but the writer inclines to look for even closer natural affinity with the *Cistiflorae*, a view that has been already reached by Warming.

Uses (Nutzen). The *Sarraceniaceae* yield no product of special economic importance. The extract of the rhizome of *S. purpurea* was once in repute as an antidote in smallpox, but seems to have no medicinal value. An alcoholic extract from the rhizome of *S. flava* is at times used in the Southern States as a stomachic and tonic, but the plant constituent of the preparation is of doubtful value. As greenhouse plants all of the species have attracted much attention, and large exportations have been made from America to European growers. All of the species succeed readily under cultivation, if grown in a greenhouse near to the glass, with eastern or southeastern exposure, in a fine sandy muck or mud, and with the tips of their roots in constant contact with water.

Systema familiae.

A. Ascidia suberecta ore sursum verso, bilamellae (alae) ventrales ascidii distinctae. Petala 0. Apex styli truncatus . . 1. *Heliamphora* Benth.

B. Ascidia erecta spiraliter torta ore deorsum verso, bilamellae ventrales ascidii in alam mediam conjunctae. Petala 5. Apex styli 5-radiatus . . . . . 2. *Darlingtonia* Torr.

C. Ascidia erecta, suberecta vel decumbentia ore sursum vel oblique vel deorsum verso, bilamellae ventrales ascidii in alam mediam conjunctae. Petala 5. Apex styli late expansus umbraculiformis . . . . . 3. *Sarracenia* L.

1. Heliamphora Benth.

*Heliamphora**) Benth. in Trans. Linn. Soc. XVIII. (1841) 429, in Proc. Linn. Soc. I. (1840) 53; Schomburgk, Reisen Brit. Guiana II. (1848) 263, III. (1848) 1090; Benth. et Hook. f. Gen. I. (1867) 48; DC. Prodr. XVII. (1873) 6; Wunschmann in Engl.-Prantl, Pflzfam. III. 2. (1891) 251; Hook. f. in Bot. Magaz. CXVI. (1890) t. 7093; Im Thurn et Oliver in Trans. Linn. Soc. New Ser. II. (1887) 263, 271; Im Thurn in Gard. Chron. (1888) I. 298; Macfarlane in Ann. of Bot. III. (1889) 259, VII. (1893) 414; Krafft, Gattung Heli. (1898) 1; N. E. Brown in Trans. Linn. Soc. New Ser. VI. (1901) 5, 18; Allard in Gard. Chron. 3 Ser. XXXVII. (1905) 194.

Flores nutantes apetali. Sepala 6—4, patula, petaloidea. Stamina ∞. Pistillum tricarpellatum; ovarium ovatum ± pubescens triloculare, stylus simplex apice truncatus, stigma parvum obscure trilobum. Capsula trilocularis dehiscens trivalvis. Semina late alata suborbiculata, discus ovoideus ad obovatus, testa laxe reticulata. — Herbae uliginosae Americae australis. Folia omnia ascidiformia suberecta, ascidia tubulosa usque amphoriformia ore obliquo operculata, antice alata, alae distinctae divergentes vel fronte ± inclinatae, supra in marginem peristomii prolongatae, operculum apice postico ascidii situm, parvum, orbiculatum, intus glandulosum; ascidium intus superne ± pilis deflexis vestitum, medio glabrum, basi pilis brevibus sparse obtectum. Scapus erectus, racemosus, bracteatus, 6—4-florus, pedicelli graciles, uniflori, alterni, in axillis bractearum amplexicaulium.

Genus monotypicum auctori inter *Nepenthes* et *Sarracenia* intermedium esse videtur.

1. **H. nutans** Benth. l. c. — *Sarracenia nutans* D. Dietr. Syn. pl. III. (1843) 260. — Rhizoma cylindricum 4—10 cm longum × 2—6 mm latum; folia omnia ascidiformia, juniora tubulosa, altiora amphoriformia, ore 10—30 cm × 3—8 cm; petiolus cylindricus antice alis divergentibus basi amplexicaulibus instructus; ascidium sensim in

*) "I have derived the generic name from ἕλος, a marsh, and ἀμφορεύς a pitcher". (Bentham l. c.).

os oblique expansum, alatum, alae e basi ad marginem oris extensae et cum eo continuae, extus sparse hirsuta vel glabra, alae marginibus ± hirsutae, os oblique ovatum antice angustatum apertum, postice in operculum parvum concavum erectum vel reflexum glanduliferum productum; ascidium intus a margine usque ad tertiam partem altitudinis pilis numerosis deflexis obsitum (suprema tantum parte in foliis magnis saepius glabra), medio glabrum, infra setis brevibus minutis conspersum. Scapus 40—60 cm longus × 2—3 mm crassus, basi vel versus medium unico (rarius duobus) folio amplexicauli simplici vel ascidiformi instructus. Racemus 10—20 cm longus, 6—3-florus; bracteae ovatae vel orbiculatae, amplexicaules; pedicelli 0,5—5 cm longi, graciles deflexi. Sepala 3—5 cm × 1—2 cm ovato-lanceolata, alba vel purpureo-alba. Petala 0. Stamina ∞, 7—9 mm longa, glabra, antheris reclinatis. Ovarium 3—4 mm, ovatum, dense albido-pubescens; stylus glaber, apice truncatus. Capsula 1,5—2 cm × 1 cm, obovata, sparse pubescens, ab apice depressa deorsum dehiscens. Semina 3 mm diametro, brunneo-aurea.

Brit. Guiana: An sumpfigen Orten des Roraima-Berges; blüht im November und Dezember. — Am Fuße des Berges (Schomburgk n. 645; Burke); am südlichen Abhange (Boddam-Whetham); auf dem Gipfel (Im Thurn n. 258 (1884), n. 78 (1894), n. 679 (1898); (Mc Connell und Quelch).

2. **Darlingtonia** Torr.

*Darlingtonia**) Torrey in Smithson. Contrib. VI. (1853) 1, et in Torrey Bot. Bull. II. (1871) 14; Gray in Amer. Journ. Sc. 2. ser. XVI. (1853) 425, et in 2. ser. XXXV. (1863) 136; Morren in Belg. Hort. V. (1855) 113; Walpers, Rep. Ann. IV. (1857) 169; Planchon in Fl. d. serres XIV. (1861) 125; Oudemans, De Bekerpl. (1863) 1; Benth. et Hook. f. Gen. I. (1867) 48; Moore in Fl. Mag. (1869) t. 457; Thurber in Amer. Agric. (1870); Hook. f. in Bot. Mag. XCVII. (1871) t. 5920; A. DC. Prodr. XVII. (1871) 3; André, Illustr. hort. XVIII. (1871) 156; Robinson in Gard. Chron. (1871) 46; Masters in Gard. Chron. (1871) 835; Baill. Hist. pl. III. (1872) 92; Torrey, Bot. Wilkes Exped. XVII. (1873) 221; Hook. f. in Report Brit. Assoc. (1874) 110; Canby in Proc. Amer. Assoc. Adv. Sc. XXIII. (1874) 64, et in Oesterr. Bot. Zeitschr. XXV. (1875) 287; Edwards in Proc. Calif. Acad. Arts. Sc. VI. (1875) 161; Watson, Bot. of Calif. I. (1876) 17; Kurtz in Verhand. Bot. Vereins Brand. XX. (1878) 5; Hooper in Calif. Hort. IX. (1879) 13; Wunschmann in Engler u. Prantl, Pflzfam. III. 2. (1891) 252; Macfarlane in Ann. of Bot. VII. (1893) 403; Howell in Erythea III. (1895) 179 sub nom. *Chrysamphora*, et in Fl. N. W. Amer. (1903) 30. — Non *Darlingtonia* DC. quae *Desmanthus* et *Neptunia* est, nec *Darlingtonia* Torr. (1848?) quae *Styrax californicum* Torr. est. — *Chrysamphora* Greene in Pittonia II. (1891) 191; Howell vide supra.

Flores solitarii, nutantes, in fructu erecti. Sepala 5, herbacea, patentia. Petala 5, supra medium constricta. Stamina 15. Pistillum 5-carpellatum; ovarium obconicum 5-loculare, loculis cum sepalis alternantibus; stylus cylindricus superne 5-radiatus, stigmatibus terminalibus; placentae ovarii magnae diffusae, ovula ∞ anatropa. Capsula loculicide valvis 5 ab apice dehiscens. Semina obovato-clavata, inferne elongata, raphe inconspicua, testa papillosa, tegmen tenue; embryo parvulus cylindricus basi albuminis granuloso-farinacei situs. — Herbae uliginosae Californiae septentrionalis et Oregonis australis. Folia omnia ascidiformia (rarissime squamiformia, vide p. p. 3, 9), erecta, cylindrica; petiolus solidus alatus alis amplexicaulibus; ascidium elongato-tubulosum spiraliter tortum, superne sensim ampliatum, antice unialatum, ala a basi ad os extensa, apice in cucullum magnum compresso-globosum albido-maculatum os obtegentem expansum; os deorsum versum; operculum processum bifidum ab ore dependentem formans, glandulis multis minutis nectariferis obtectum; ascidium intus in parte cucullata pilis validis et glandulis conspersum, dein ab ore minute pilosum, inferne pilis

*) Dicat. Dr. Guil. Darlington, West Chester, Pennsylvania.

longis gracillimis deflexis obsitum. Scapus erectus, apice nutans, in statu fructifero erectus, bracteatus; bracteae alternae ± dissitae.

Genus monotypicum Americae occidentalis.

1. **D. californica** Torrey l. c. — *Chrysamphora californica* (Torr.) Greene l. c.; Howell l. c. — Rhizoma 10—15 cm × 10—15 mm, saepe ramosum, ramis gracilibus. Folia ascidiformia, 10—110 cm longa × 5—8 cm, cylindrica; ascidium tubulosum glabrum coriaceum viride, ad cucullum postice albo- et rubro-areolatum et maculatum; ala e basi ad os circulare ampliata; peristomium involutum glandulosum margine interiore pilis deflexis obtectum; operculum bifidum dependens viridi-rubrum glandulosum; ascidium intus parte cucullata pilis multis deflexis et glandulis minutis onustum, dein ab ore ad dimidiam vel tertiam partem glabrum nitidum, infra pilis multis longis deflexis conspersum. Scapus 30—100 cm longus × 4—5 mm diam., erectus, apice recurvus, glauco-viridis bracteae 9—6 spiraliter ordinatae, inferiores inter se distantes, superiores circum florem congestae, semiamplexicaules, oblongae, glauco-virides. Flos 5—8 cm diam. solitarius, nutans, in fructu erectus. Sepala 5, 3—5 cm × 8—12 mm, lanceolata, concava, patentia, pallido-viridia. Petala 4—5 cm × 1,5 cm, ovata, supra medium contracta, superiore parte linguiformia, concava, convergentia, viridia vel rubro-lutea, venis rubris longitudinalibus. Stamina 15, rarius ad 12, 10—12 mm longa, filamentis antherisque aequilongis. Ovarium obconicum, apice medio depressum, 5-lobum, 5-loculare; stylus crassus, superne in ramos 5-radiatos apice stigmatiferos divisus; stigmata minute papillosa; placentae bilobae, spongiosae, ovulis multis parvis obsitae. Capsula 3—4 cm longa × 2 cm diam., obovata, 5-sulcata, loculicide ab apice dehiscens, sepalis persistentibus cincta. Semina obovato-clavata, testa membranacea, setis squarrosis conspersa.

Fig. 9. *Darlingtonia californica* Torr. (Sec. Bot. Magaz. t. 5920).

An feuchten und sumpfigen Orten der Gebirge von Nord-Californien bis Süd-Oregon, in einer Höhe von 700—2700 m ü. M.; blüht Mai bis Juli.

Californien: Lake City, Nevada Co. (Davis); Fern Dell, Plumas Co. (Austin); am Südabhange des Shasta Mt. (Brackenridge, Hulse, Brewer), auf der Westseite desselben Berges (Wood), sowie auf dessen Nordseite (Brown); Sierra Co., ohne Standortsangabe (Lemon); Sweet Brill Camp, Shasta Co. (Parsons); auf dem Eddy-Berg, Siskiyou Co. (Copeland, Krautter); Strawberry Valley, Siskiyou Co. (Hooker u. Gray).

Oregon: Eight Dollar Mt, Waldo Co. (Howell); Kerbyville, Josephine Co. (Howell); Myrtle Point, Coos Co. (Diller).

3. Sarracenia L.

Sarracenia L.*) Spec. pl. ed. 1. (1753) 510; Catesby, Nat. Hist. Carolina II. (1754) 69; Smith, Corr. Linn. I. (1765) 69; Walter, Fl. Carol. (1788) 152; W. Bartram, Travels ed. 2. (1794) XII. 415; Michx. Fl. bor. amer. I. (1803) 310; J. E. Smith, Exot. Bot. I. (1804) 103; Curtis, Botan. Mag. (1804) t. 780, (1805) t. 849, (1815) t. 1710, (1836) t. 3515; Pers. Synops. II. (1807) 62; Pursh, Fl. Amer. sept. II. (1814) 367; Macbride in Trans. Linn. Soc. XII. (1815) 48; de la Pylaie in Ann. Soc. Linn. Paris VI. (1827) 379; Nutt. Gen. N. Amer. Pl. II. (1818) 11, et in Trans. Amer. Phil. Soc. N. S. IV. (1834) 49; Elliott, Bot. S. Car. II. (1824) 9; DC. Organ. Vég. I. (1827) 319; Reichb. Flor. Exot. I. (1834) 10; Torrey et Gray, Fl. N. Amer. I. (1838) 59; Sweet, Brit. Fl. Gard. V. (1838) t. 138; Croom in Amer. Journ. Sc. XXV. (1834) 75, XXVI. (1834) 316, in Ann. Lyc. Nat. Hist. N. Y. IV. (1848) 95; Torrey, Nat. Hist. N. Y. I. (1843) 41; Walp. Repert. II. (1843) 25; Gray, Gen. Fl. Amer. I. (1848) 107; Lindl. Introd. to Bot. I. (1848) 298; Decne. in Fl. des serres VII. (1851) 264, et in Rev. Hort. I. (1852) 121; Planchon in Fl. des serres X. (1855) 233, 243, 247; Chapman, Fl. S. U. States (1860) 20; Oudemans, De Bekerplanten (1863); Baill. Hist. pl. III. (1872) 103; Hooker f. in Brit. Assoc. Report (1874) 107; Otto in Hamburg. Gart. Zeitg. XXXV. (1879) 337; Masters in Gard. Chron. ser. 2. XV. (1881) 817, XVI. (1881) 11; Meehan, Fl. and Ferns of U. S. ser. 2. I. (1870) 5, 21, 37; Zipperer, Kennt. d. Sarr. (1885); Wunschmann in Engl. u. Prantl Pflzfam. III. 2. (1891) 244; Gray, Synopt. Fl. N. Amer. I. (1895) 79; Beck v. Mannagetta in Wien. Ill. Gart. Zeitg. XX. (1895) 456; Mohr, Plant Life of Ala. (1901) 117, 530; Small, Fl. S. E. U. States (1903) 493; Harper in Bull. Torr. Bot. Club XXVII. (1900) 428, XXX. (1903) 331, XXXI. (1904) 22, XXXIII. (1906) 236; Macfarlane in Contrib. Bot. Lab. Univ. Penn. II. (1904) 426, in Trans. Roy. Hort. Soc. Conf. Genetics (1907) 155, Journ. of Bot. XLV. (1907) 1. — *Bucanephyllon* Plukenet Phytogr. (1691) t. 152. — *Bucanephoron* Pluk. Almag. (1696) 71. — *Coilophyllum* Morison, Plant. Hist. (1699) 533. — *Nepenthes* Breyn. Prodr. (1739) 85. — *Sarracena* Tourn. Inst. (1719) 657; L. Hort. Cliff. (1737) 497; P. Miller in Gard. Dict. ed. 6. (1752); Adans. Fam. II. (1763) 450. — *Sarraxinia* Hoffmannsegg, Verzeichn. d. Pfl. (1824) 223.

Flos in scapo solitarius nutans, in fructu nutans vel ± erectus; bracteae tres, ovales concavae parvae, sepalis arcte adpressae. Sepala 5 ovata, expansa, herbacea vel petaloidea, persistentia. Petala 5 ± panduriformia, sub medio contracta et basi inter lobos stylorum inflexa, apice flaccido dependente. Stamina ∞, antheris saepe initio ab apice dein longitudinaliter dehiscentibus. Pistillum 5-carpellatum; ovarium dense glanduloso-tuberculatum, 5-loculare, loculis sepalis oppositis; stylus inferne cylindricus, superne in umbraculum magnum 5-lobatum expansus, lobis bifidis, stigmatibus papillosis parvis intra basim bifidam. Capsula rotundata, ± 5-loba, tuberculata, umbraculo styli coronata, fissuris lateralibus dehiscens. Semina numerosa, parva, ovata vel obovata, minute reticulata vel tuberculata; raphe saepe conspicua. — Herbae humidae uliginosae et paludosae, regionem orientalem Americae septentrionalis incolentes. Folia erecta v. ascendentia v. procumbentia, petiolata, glabra v. parce pubescentia et glandulis minutis conspersa; petiolus cylindricus solidus alatus, basi et alis expansis amplexicaulibus; foliorum lamina dimorphia vel trimorphia, folia vernalia (in speciebus omnibus obvia) ascidiformia, ascidium extus tubulosum vel ventricosum, parte ventrali unialatum, ala ab basi ad os prolongata; os sursum v. oblique v. deorsum rectum; operculum rectum et ± expansum, vel concavum et supra os inclinatum, vel apice ascidii postice conjunctum et valde cucullatum; ascidium intus ab ore versus medium glabrum, inferne

*) Genus a Tournefortio dicat. Dr. Sarrasin in Quebec, N. A., non Jean A. Sarracin in Lyons (1598 A. D.). Vide Tournefort, Instit. I. p. 657. »Sarracenam appellavi a Clarissimo D. Sarrazin« (err. pro Sarrasin, vide Mém. de l'Acad. Roy. d. Sc. XIX. (1704) 48. — *auctor*) »Medicinae Doctore, Anatomico et Botanico Regio insigni, qui eximiam hanc plantam pro summa qua me complectitur benevolentia e Canada misit«, et Macfarlane in J. of B. v. s.

pilis longis deflexis vestitum; folia aestivalia (in speciebus nonnullis deficientia) aut vernalibus similia aut vulgo simplicia non-ascidiformia, costam solidam ala ventrali ± late expansa instructam formantia; folia autumnalia brevia squamiformia amplexicaulia imbricata. Scapus nudus erectus, sub flore recurvus.

Species 7, Americae orientalis incolae.

Conspectus specierum.

A. Ascidia erecta; flores flavi vel albido-flavi.
  a. Ascidium ore postice albido-maculatum; operculum valde concavum; flores lutei . . . . . 1. *S. minor.*
  b. Ascidium ore postice viride, in venis vel omnino rubro-purpureum; operculum suberectum ad erectum; flores albido-lutei . . . . . 2. *S. Sledgei.*
  c. Ascidium ore postice viride, vel viride venis rubro-purpureis, vel omnino rubro-purpureum; operculum late cordatum suberectum basi marginibus revolutum; flores flavi . . 3. *S. flava.*

B. Ascidia erecta ad decumbentia; flores ± rubro-purpurei.
  a. Ascidium erectum, sub ore albo-maculatum; operculum erectum albo-maculatum; flores viridi-purpurei . . . . 4. *S. Drummondii.*
  b. Ascidium erectum, circum os viride venis rubro-purpureis; operculum laeve concavum venis rubro-purpureis; flores parvi, rubro-purpurei . . . . . 5. *S. rubra.*
  c. Ascidium ascendens, ventricosum; operculum erectum; flores viridi-purpurei . . . . . 6. *S. purpurea.*
  d. Ascidium procumbens tubulosum, cum operculo valde cucullatum, albo-maculatum; flores rubro-purpurei . . 7. *S. psittacina.*

1. **S. minor** Walt. Fl. Carolina (1788) 153; Willd. spec. II. (1799) 1150; Pers. Synops. II. (1807) 62; Spach, Hist. vég. XIII. (1846) 330; Small, Fl. S. E. U. States (1903) 494; Harper in Bull. Torr. Bot. Club XXX. (1903) 331. — *S. variolaris* Michx. Fl. bor. amer. I. (1803) 310; Pursh, Fl. Amer. sept. II. (1814) 367; Bot. Magaz. XLI. (1815) t. 1710; Elliott, Bot. S. Car. II. (1824) 11; Croom in Ann. Lyc. Nat. Hist. New York IV. (1848) 102; Torrey et Gray, Fl. N. Amer. I. (1838) 59; Chapman, Fl. S. U. States (1860) 21; DC. Prodr. XVII. (1873) 6. — *S. adunca* Smith, Exot. Bot. I. (1804) 103. — non *S. lacunosa* W. Bartram, Travels ed. 2. (1794) 415, quae *S. Drummondii* est. — Rhizoma 15—18 cm longum × 1,5—2,5 cm crassum ± sinuosum, radicibus rubro-fulvis. Folia dimorphia, (*a*) vernalia ascidiformia, (*b*) autumnalia squamiformia. Vernalia ascidiformia 12—75 cm longa × 2—4 cm diam. (vulgo 20 × 2,5) erecta, glabra vel parce pubescentia, per hiemem persistentia, inferne viridia, superne viridi-brunnea et postice circum os albido-maculata et areolata; petiolus basi alatus, amplexicaulis, dein solidus cylindricus; ascidium tubulosum sensim sursum inflatum, ala ventrali in medio 1—2 cm lata, versus basin et os attenuata; os ovato-triangulare; peristomium angustum, reflexum, dense glandulosum, antice in carinas alae productum; operculum et pars postica superior ascidii valde concava, galeata; ascidium intus sub galea minute pilosum et glandulosum, ab ore tubi versus medium glabrum, infra pilis gracilibus deflexis obtectum. Folia squamiformia 5—6, 2—3 cm longa, deltoidea, acuminata, albo- ad viridi-rubra. Scapus 15—40 cm longus × 1,5—2 mm diam. viridis vel luteo-viridis; bracteae 5—7 mm × 4 mm inaequales, rubro-virides. Flos 4—6 cm latus, sicut fructus nutans, odore citrino. Sepala 2,5—3 cm × 1,5—2 cm, obtusa, ovata, viridia. Petala 4—5 cm × 1,5—2 cm, panduriformia, pallida, lutea, segmenta basalia insertione contracta, dein expansa, marginibus levissime revolutis, segmenta apicalia obovata. Staminum filamenta alba, sub antheris rubra. Ovarium 5—6 mm globoso-depressum, stylus gracilis viridi-albus, umbraculo styli 2,5—3 cm diam. Capsula

12—13 mm diam. globoso-depressa, leviter et irregulariter tuberculata. Semina 1—1,5 mm obovata, minute tuberculata, raphe carinata apice rotundata.

An feuchten sandigen Orten der östlichen Savannengebiete des südlichen N. Carolina, von S. Carolina und Georgia bis zum mittleren Florida; Blütezeit erste bis dritte Woche April. N. Carolina: Columbus Co. (Mc Carthy). — S. Carolina: Bluffton (Mellichamp); Summerville (Brownfield, Macfarlane); Lake City, Effingham, und bis Florence (Macfarlane). — Georgia: Bloys, Bugaboo, Coffee Co. und an anderen Orten (Harper); Thomasville, Pidcocks, Valdosta, Cutting, Manor, Glenmore, Waycross, Blackshear (Macfarlane). — Florida: Smyrna, Jamong (Rugel); Eustis, Lake City (Nash); Jacksonville (Curtiss, Macfarlane); Hibernia (Canby); Gainesville (Knight).

2. **S. Sledgei** Macfarlane n. sp. — ?*S. Gronovii* var. *alata* Wood, Class Book (1861) 222. — ?*S. flava* var. *crispata* Mast. in Gard. Chron. s. 2. XVI. (1881) 12. — *S. Catesbaei* Small, Fl. S. E. U. States (1903) 494; Macfarlane in Contrib. Bot. Lab. Univ. Penn. II. (1904) 426. — non *S. Catesbaei* Elliott Bot. S. Car. II. (1824) 11 quae hybrida est (vide Macfarlane in Trans. Roy. Hort. Soc. Conf. Genetics loc. cit.). — nec *S. Catesbaei* Mohr Pl. Life of Alab. (1901) 531 quae *S. flava* est. — nec *S. Catesbaei* Harper in Bull. Torr. Bot. Club XXX. (1903) 333 quae hybrida est (vide Macfarlane l. c.) — Species sub nom. *S. flava* saepe collecta, sed structura et distributione bene distincta. Rhizoma 15—20 cm longum × 1,5—2 cm crassum, radicibus brunneo-albis. Folia trimorphia; vernalia omnia ascidiformia, 30—70 cm × 2—4 cm, erecta, tubulosa, per hiemem sub-persistentia, viridia ± rubro-nervia vel omnino atro-purpurea; petiolus basi alatus amplexicaulis, dein solidus cylindricus; ascidium sensim ab basi ad os inflatum, inferne nervis longitudinalibus prominentibus superne tenuioribus et ± rubro-purpureis coloratis percursum, ala ventralis a basi ad $^1/_3$ alt. gradatim expansa dein contracta et versus os attenuata; os ovatum; peristomium angustum recurvatum, antice in alam deflexum, postice in collum breve elevatum; operculum 4—8 cm × 3—6 cm diam. erectum vel ore leviter concavum, ovato-cordatum, inferne marginibus lateralibus aequis vel leviter recurvatis, extus glabrum, intus saepe venis atro-purpureis a basi radiantibus, infra glabrum vel nitidum, supra pilis multis minutis et glandulis minutis conspersum; ascidium intus versus dimidium tubi glaucum, basi pilis multis longis tenuibus deflexis obsitum. Folia aestivalia plerumque vernalibus similia, sed interdum folia non-ascidiformia producta sunt costa solida et ala ventrali ± expansa. Folia squamiformia 3—4, 3 cm longa, viridia. Scapus 25—60 cm longus × 3—4 mm diam., viridis; bracteae 8—10 mm × 5—6 mm, virides, marginibus membranaceis. Flos magnus 5—7 cm diam., nutans; odor inter eum violae et citri intermedius. Sepala 4—5 cm × 2,5—4 cm, ovata (externa) vel ovalia (interna), primum fulvo-viridia vel pallido-viridia et patentia, postea pallido-lutea et valde recurva, in fructu viridia. Petala obovato-panduriformia, segmenta basalia quadrata marginibus superioribus valde revolutis, omnino pallido-lutea, postea luteo-alba. Ovarium subsphaeroideum, flavo-viride; stylus albus, umbraculo styli 5—7 cm lato. Capsula sphaeroidea, dense tuberculata. Semina 0,75—1,75 mm, ovalia vel obovata, raphe prominente.

So weit bis jetzt festgestellt werden konnte, findet sich diese Art nur in den südlichen Golfstaaten vom Alabama-Fluss bis nach Südost-Texas; ihr Verbreitungsgebiet erstreckt sich etwa 150—200 km landeinwärts. Sie bewohnt feuchte sandige Savannen. — Alabama: Umgebung von Mobile, Dog River, Theodore (Macfarlane); bei Mobile (Jewett, Sullivant, Sledge). — Mississippi: Ocean Springs, Biloxi (Tracy, Macfarlane); bei Mississippi City (Canby); Bay St. Louis, Pascagoula, Bellafontain (Macfarlane). — Louisiana: bei Neu Orleans (Drummond); Hammond (Gallup); Pearl River (Cocks); Alton, Slidell (Macfarlane). — Texas: Swan (Reverchon); Kountze (Nealley).

3. **S. flava** L. Spec. pl. ed. 1. (1753) 510; Catesby, Nat. Hist. Carolina II. (1754) 69; Walter, Fl. Carolina (1788) 153; Michx. Fl. bor. amer. I. (1803) 310; Curtis, Bot. Magaz. XX. (1804) t. 780; Pursh, Fl. Amer. sept. II. (1814) 367; Elliott, Bot. S. Carolina II. (1824) 10; Torrey et Gray, Fl. N. Amer. I. (1838) 59; Croom in Ann. Lyc. Nat. Hist. New York IV. (1848) 103; Decne. in Fl. des serres VII. (1851) 266;

Planchon in Fl. des serres X. (1855) 233; Chapman, Fl. S. U. States (1860) 21; Masters in Gard. Chron. s. 2. XVI. (1881) 11; DC. Prodr. XVII. (1873) 5; Small, Fl. S. E. U. States (1903) 494. — *S. Gronovii* var. *flava* Wood, Class Book (1861) 222. — *S. Rugelii* Shuttlew. msc. — non *S. flava* auct. quoad specimina in Mississippi, Louisiana, Texas et parte in Alabama lecta, quae ad *S. Sledgei* pertinent. — Rhizoma 15—20 cm longum × 2—2,5 cm diam. ± sinuosum. Folia trimorphia; vernalia omnia ascidiformia 20—100 cm longa, ore 3—8 cm lata, erecta, glabra vel minute pubescentia, tubulosa, autumno marcescentia; petiolus validus basi alatus, amplexicaulis, supra basin solidus cylindricus; ascidium sensim a basi ad os inflatum, nervis longitudinalibus prominentibus costiformibus dense et minute glanduliferis percursum, ala ventralis angusta, a basi ad os ascidii fere aequalis; os rotundatum, postice medio sulcatum; peristomium 3—4 mm latum, revolutum, postice marginibus inferioribus operculi valide revolutum et glandulis minutis conspersum; operculum ovatum ad ovato-orbiculare, suberectum, extus glabrum vel minute pilosum, medio carinatum, apice mucronatum vel peltatum, circa marginem glandulis multis nectariferis instructum; ascidium et operculum luteo-viridia vel intus basi operculi rubra, vel luteo-viridia et ± rubro-striata vel omnino rubro-viridia ad rubro-purpurea; tubus intus inde ab ore et versus basin operculi usque ad $^1/_3$ alt. glauco-viridis vel glauco-purpureus, basi pilis multis tenuibus conspersus. Folia aestivalia rarissime angusto-ascidiformia, vulgo omnia simplicia, 5—45 cm longa, plerumque costa media postice complanata et ala ventrali lata onusta, apicem versus abrupte vel sensim acuminata. Folia autumnalia 4—5, squamiformia, triangula, acuminata, alborubra. Scapus 30—50 cm longus × 4—5 mm diam. basi et apice brunneus, erectus, apice nutans, in fructu erectus; bracteae 13—15 mm × 7—10 mm, concavae, ovato-obtusae, rubro-virides. Flos magnus 5—10 cm diam. nutans, in fructu suberectus vel erectus, odore vespertino ingrato. Sepala externa (3) 4—5 cm × 3,5—4 cm, late ovata, flavo-viridia, sepala interna (2) 5 cm × 2,5—3 cm, ovalia vel subovata, viridi-flava. Petala 7—9 cm × 3—4 cm, segmenta basalia cuneata, dein leviter contracta et marginibus ± revolutis, segmenta apicalia obovata, ± revoluta, flava. Staminum filamenta alba, antherae 3—4 mm aureae, primum poris terminalibus demum longitudinaliter dehiscentes. Ovarium 7—8 mm, sphaeroideo-ovatum, tuberculato-glanduliferum, basi viride apice flavum; stylus 13—15 mm longus, umbraculo styli 6—9 cm lato, flavo-viridi. Capsula 2 cm lata, sphaeroideo-depressa,

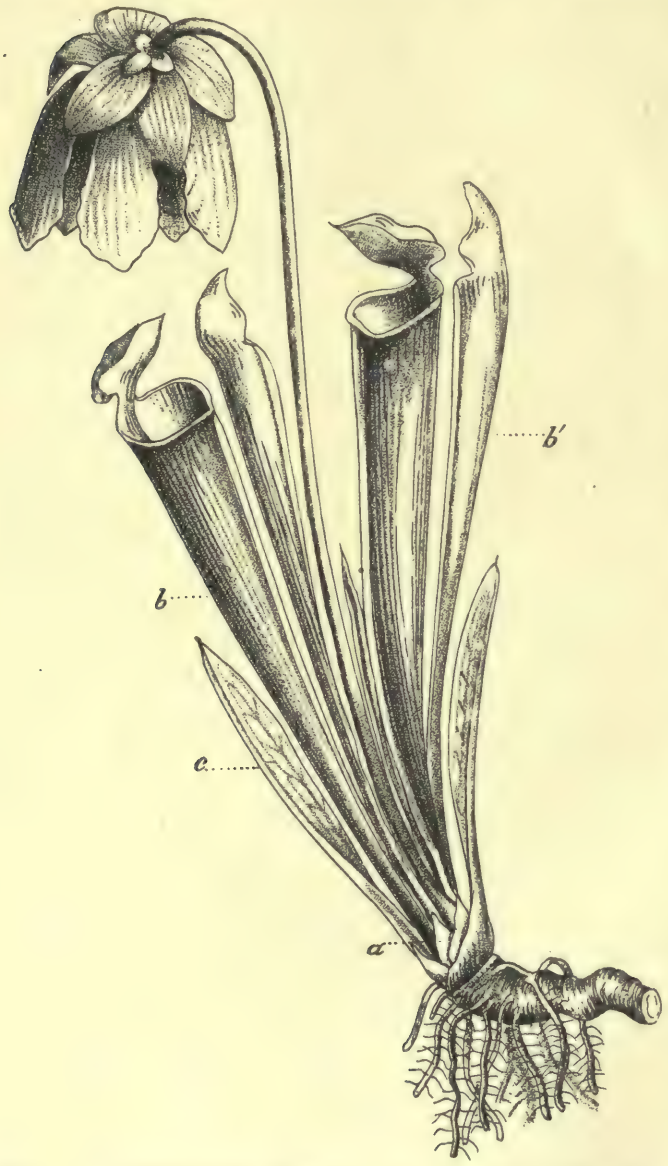

Fig. 10. *Sarracenia flava* L., *a* folia squamiformia, *b* f. ascidiformia, *b'* eadem statu juvenili, *c* f. phyllodinea. (Origin.)

dense et profunde tuberculata. Semina 2 mm × 1 mm, ovalia, depressa, raphe obscura, testa tuberculis conspersa.

Varietates subsequentes (vel si mavis lusus) ab auctoribus variis pro varietatibus vel speciebus habitae, mihi videntur certe valde variabiles. Omnes varietates vero a me ipso collectae sunt, loco natali saepissime intermixtae vigent.

Var. a. **media** Macfarlane n. var. — Folia statura media, fauce viridia vel rubro-striata.

Var. b. **maxima** Masters in Gard. Chron. s. 2. XVI. (1881) 12. — Folia magna, luteo-viridia.

Var. c. **ornata** Cat. Hort. Bull. et in Gard. Chron. l. c. — Folia magna, fauce ascidii purpureo-radiata = *S. Fildesii* Hort. Nicholson Dict. of Gard. III. (1886) 363.

Var. d. **Rugelii** (ut sp. vid.) Shuttlew. msc. et Masters in Gard. Chron. l. c. 11 = Var. *erythropus* Cat. Bull. — Folia magna, fauce ascidii et basi operculi purpurea.

Var. e. **limbata** Cat. Hort. Bull. et Masters in Gard. Chron. l. c. — Folia media, margine operculi intus purpurea.

Var. f. **atro-sanguinea** Cat. Hort. Bull. et Masters in Gard. Chron. l. c. — Ascidium operculumque ± atro-purpurea.

Var. g. **minima** Masters in Gard. Chron. l. c. — Folia parva saepe purpureo-venosa.

Häufig von Süd-Virginia bis Alabama und Nord-Florida. Die Art wächst in flachen Savannen-Gebieten, die während des Sommers ziemlich trocken sein können, oder sie wird am Rande von Sümpfen angetroffen. Ihr Verbreitungsgebiet erstreckt sich 250—600 km landeinwärts von der atlantischen Küste. Was die Verbreitung dieser und der nahe verwandten *S. Sledgei* betrifft, so muss hervorgehoben werden, dass an den bisher aus W. Alabama, Mississippi, Louisiana und Süd-Ost-Texas für *S. flava* angegebenen Standorten nur *S. Sledgei* vorkommt, die man mit *S. flava* verwechselt hat. Blütezeit: dritte Woche des März bis vierte Woche des April.

Virginia: Southampton Co. (Pickering); bei Petersburg (Toumey). — N. Carolina: Wadesboro (Donnell-Smith); Hickory (Small und Heller); von Lemon Springs bis Aberdeen (Harper); Burgaw (Hyams); Lafayette (Beadle); Newbern (Kearney); Wilmington, Castle Hayne, Wallace, Hamlet (Macfarlane). — S. Carolina: Chesterfield (Macbride, Macfarlane); Summerville (Donnell-Smith, Macfarlane); Bonneau, Mount Holly, St. Stephen, Lake City, Coward, Effingham, Florence (Macfarlane). — Georgia: Clinch Co. (Canby); Macon (Tracy); Cordele bis Tifton (Harper); Ruskin (Macfarlane, Harper); Boston, Pidcock, Whitmans, Valdosta, Blackshear, Patterson, Offermann (Macfarlane). — Alabama: Valley Head (Mohr, Ruth sub nom. *S. Catesbaei*, Beadle); Pisgah (Beadle); Bay Minette, Atmore (Macfarlane). — Florida: bei Quincy (Rugel); Wewahitchka (Chapman); Crest View (Beadle); Mulat, Holts, Milligan, Deer Land, von De Funiak Springs bis Ponce de Leon, Westville, Caryville, Bonifry, Chipley, von Marianna bis Cypress Lake, Ochesee (Macfarlane).

Einheim. Namen: Fly Catchers; Trumpets; Trumpet-Leaf; Watches.

4. **S. Drummondii** Croom in Ann. Lyc. Nat. Hist. New York IV. (1848) 100; Planchon in Fl. des serres VI. (1850) 81, X. (1855) 239; Chapman, Fl. S. U. States (1860) 21; Masters in Gard. Chron. n. ser. XVI. (1881) 11; DC. Prodr. XVII. (1873) 5; Small, Fl. S. E. U. States (1903) 494. — *S. lacunosa* W. Bartram Travels ed. 2. (1794) 415. — *S. leucophylla* Raf. Fl. Ludov. (1817) 14. — *S. Drummondii* Lindl. et Paxt. Flor. Gard. I. (1850—51) 1 t. 1. — *S. undulata* Decne. in Rev. Hort. 1. (1852) 126. — *S. Gronovii* var. *Drummondii* Wood Class Book (1861) 222. — Rhizoma 15—25 cm longum × 2—2,5 cm diam. ± sinuosum. Folia trimorphia; vernalia omnia ascidiformia 30—90 cm longa, ore 1—6 cm lata, erecta, tubulosa, autumno marcescentia; petiolus validus cylindricus usque triangularis basi alatus expansus amplexicaulis; ascidium sensim ab basi ad os inflatum venis subprominentibus et glanduliferis percursum; ala ventralis medio 1—2 cm lata versus basin et os attenuata; os obliquum, orbiculare ad ovoideum, postice in collum elongatum; peristomium revolutum antice ad alam deflexum, postice marginibus in collum prolongatum; operculum orbiculare 2—8 cm

diam., erectum vel suberectum, margine undulatum, intus pilis longis albis deflexis onustum; ascidium extus glabrum, infra viride, supra sub ore et per totum operculum albo- et rubro-areolatum et maculatum; ascidium intus ad $^1/_4$—$^1/_3$ alt. glauco-viride, basi pilis multis tenuibus conspersum. Folia aestivalia plerumque vernalibus similia sed saturatius colorata, eis intermixta sunt folia e costa dorsali ala ventrali late expansa composita, eis in *S. flava* obviis similia tantum pauca sunt producta. Folia autumnalia squamiformia 5—6, 2—3 cm longa, basi late expansa, apice acuminata, albido- ad rubro-viridia. Scapus 50—100 cm longus × 3—4 mm diam. erectus, apice in flore et fructu nutans, basi viridis, saepe sub flore purpureus; bracteae 10—13 mm × 8—10 mm, viridi-rubrae ad purpureae. Flos 7—8 cm latus. Sepala 4,5—6 cm × 3—4 cm, ovata, extus purpurea intus viridia margine purpurea. Petala 6—7 cm × 2—2,5 cm, segmenta basalia rhomboidea, basi viridia, superne purpurea, margine superiore valde revoluta, segmenta apicalia obovata rubro-purpurea. Staminum filamenta rubro-alba ad alba. Ovarium ovatum, rubro-viride; stylus basi ruber superne albus, umbraculo styli 5—7 cm lato extus et intus rubro-viridi. Capsula 2,5—3,5 cm diam. Semina 2 mm × 1 mm obovata vel obconica, minute tuberculata, raphe prominente.

In feuchten sandigen Gebieten und in Sümpfen von Süd-Central-Georgia und Nordwest-Florida bis zum Alabama-Fluss, das Verbreitungsgebiet erstreckt sich von der Golfküste aus 150—230 km landeinwärts. Blütezeit zweite bis vierte Woche des April. — Florida: Appalachicola (Drummond, Chapman); Ochesee (Chapman, Macfarlane); Pensacola (W. Bartram, Robin, Macfarlane); Andalusia, Greenville, Deer Land, Milligan, Mulat, Fort Barranca, Molino, Pine Barrens, Century (Macfarlane). — Alabama: Bay Minette (Tracy, Macfarlane); Flomaton, Perdido, Brewton, Brooklyn (Macfarlane). — Georgia: Americus (Harper).

5. **S. rubra** Walt. Fl. Carolina (1788) 152; Bot. Magaz. LXIII. (1836) t. 3515; Elliott, Bot. S. Carolina II. (1824) 10; Torrey et Gray, Fl. N. Amer. I. (1838) 59; Croom in Ann. Lyc. Nat. Hist. New York IV. (1848) 99; Decne. in Fl. des serres VII. (1851) 266; Planchon l. c. X. (1855) 233; Chapman, Fl. S. U. States (1860) 21; DC. Prodr. XVII. (1873) 4; Small, Fl. S. E. U. States (1903) 494. — *S. Sweeti* DC. Prodr. l. c. — *S. Gronovii* var. *rubra* Wood, Class-Book (1861) 222. — *S. minor* Sweet, Flower Gard. ser. 2. t. 138. — *S. rubra* var. *acuminata* DC. Prodr. l. c. vix differt a forma typica. — Rhizoma 5—7 cm longum × 5—7 mm diam., transverse anguste striatum, radicibus 6—8 cm longis albo-luteis. Folia dimorphia; folia vernalia omnia ascidiformia 10—75 cm longa, ore 0,5—2,5 cm lata, erecta, per hiemem subpersistentia; petiolus basi albus alatus, amplexicaulis, superne gracilis cylindricus; ascidium cylindricum ad medium sensim expansum, superne sub ore tubulosum, ala ventralis a basi ad os fere aequalis vel medio leviter expansa, venis longitudinalibus et obliquis ascidii ± purpureis, os sursum versum, rotundatum; peristomium 0,5—1 mm latum revolutum, purpureo-rubrum, antice crassius et apice ala conjunctum; operculum 1—4 cm × 0,5—2,5 cm, ovatum, leviter concavum, apice acuminatum, costa media prominente, intus pilis tenuibus deflexis et glandulis minutis conspersum; ascidium intus ab ore versus dimidium glauco-viride et rubro-reticulatum, basi pilis tenuibus deflexis instructum. Folia autumnalia squamiformia 2—4, 12—15 cm longa, attenuata, alba, apice brunneo-viridia. Scapus 20—50 cm longus, 2—3 mm diam., glauco-viridis, apice in flore et fructu nutans; bracteae 4—10 mm × 3—7 mm, viridi-striatae. Flos 3—4 cm latus, odore violaceo. Sepala 2—3 cm × 1—1,5 cm, ovata vel elliptica, extus basi rubro-viridia apice viridia, intus pallido-viridia. Petala 2,5—4 cm × 1,5—2 cm, segmenta basalia cuneata infra medium creberrime constricta et revoluta, insertione alba superne rubra, segmenta apicalia obovata, extus purpurea, intus purpureo-viridia. Staminum filamenta alba, sub antheris rubra. Ovarium 4—5 mm ovoideum, pallido-viride, umbraculo styli 3—3,5 cm lato, profunde quinquelobo. Capsula 6—7 mm, ovalis, tuberculata, raphe prominente, testa sub raphe depressa.

Eine sehr weit verbreitete Art, die jedoch selten an einem Standorte in größerer Anzahl von Individuen auftritt. Sie kommt von allen Arten am spätesten zur Blüte; je

nach dem Standorte blüht sie in der dritten Woche des April, oder auch erst Ende Mai. — N. Carolina: Muddy Creek, Henderson Co. (Donnell-Smith); Columbus Co. (Mc Carthy); Biltmore, Fayetteville (Beadle); Wilmington (Macfarlane). — S. Carolina: Flat Rock (Rugel); bei Chesterfield (Ward); bei dem Wateree-Fluss (Herb. J. Bartram unter dem Namen *S. media*); zwischen Aiken und Augusta (Macfarlane). — Georgia: Americus, Graymont, Stillmore (Harper). — Florida: Crestview (Beadle); De Funiak Springs (Curtiss, Beadle); Mulligan (Macfarlane). — Alabama: Buckley (Curtiss); Bay Minette (Macfarlane).

6. **S. purpurea** L. Spec. pl. ed. 1. (1753) 510; Catesby, Nat. Hist. Carolina II. (1754) 70; Walter, Fl. Carolina (1788) 152; Michx. Fl. bor. amer. I. (1803) 310; Curtis, Bot. Magaz. XXII. (1806) t. 849; Pursh, Fl. Amer. sept. II. (1814) 367; Elliott, Bot. S. Carolina II. (1824) 9; Torrey et Gray, Fl. N. Amer. I. (1838) 59; Torrey, Nat. Hist. New York I. (1843) 41; Croom in Ann. Lyc. Nat. Hist. New York. IV. (1848) 95; Planchon in Fl. des serres X. (1855) 247; Chapman, Fl. S. U. States (1860) 21; DC. Prodr. XVII. (1873) 4; Britton et Brown, Fl. N. States and Canada II. (1897) 159; Small, Fl. S. E. U. States (1903) 493. — *S. heterophylla* Eaton Manual ed. 4. (1824) 445 est var. luteo-virescens. — Rhizoma 3—4 cm longum, 10—12 mm diam., rarissime ramosum rami 5—6 mm diam., radicibus 15—20 cm longis, rubro-brunneis. Folia subtrimorphia; folia vernalia omnia ascidiformia 6—35 cm longa, medio 2—10 cm diam., ascendentia, radiata; petiolus basi alatus, expansus, amplexicaulis, superne cylindricus, ruber; ascidium pyriforme, dorso ventricosum, ventre ± rectum vel convexum, versus os leviter contractum ± pilosum; ala ventralis late expansa medio versus basin et os contracta; os sursum versum, ovale; peristomium 1—3 mm latum, recurvatum, semicirculare, glandulis multis minutis conspersum; operculum deltoideum apice emarginatum intus pilis multis subsetosis et glandulis conspersum; ascidium intus ab ore ad 1—3 cm altid. nitido-glandulosum, infra ad 2—12 cm altid. glabrum et glandulosum, basi pilis multis longis deflexis instructum; folia aestivalia rarissime producta vel si adsunt vernalibus similia, vel ascidium anguste tubulosum et alam ventralem expansam gerens (*S. heterophylla* Eaton); folia autumnalia squamiformia 2—4, 2—3 cm longa, rubra ad viridi-rubra. Scapus 20—40 cm longus, 4—5 mm diam. infra viridis, superne sub flore viridi-ruber; bracteae 4—8 mm × 3—6 mm virides vel viridi-rubrae marginibus membranaceis. Sepala 3—3,5 cm × 2—2,5 cm extus purpureo-rubra, saepe apice viridia. Petala 4—5 cm × 2—2,5 cm obovata, sub medio constricta et leviter revoluta, insertione lutea superne purpurea vel albo-purpurea. Staminum filamenta alba. Ovarium ovatum, tuberculatum, umbraculo styli extus glabro intus sparse piloso. Capsula ovata. Semina 1,75 mm × 1 mm obovata, carinata, testa verticibus minutis conspersa.

An feuchten Orten und an Teichrändern; die Art findet sich von Labrador, Neufundland und Manitoba südlich bis Florida, Alabama und Louisiana; blüht je nach dem Standort von April bis August (s. 23).

Var. a. **typica** Macfarlane nov. var. — Sepala viridi-purpurea ad purpurea; petala purpurea; folia viridia vel rubro-viridia.

Florida: Quincy (Rugel); De Funiak Springs (Mrs. Randall); Fort Barranca, Ponce de Leon, Ochesee (Macfarlane). — Alabama: Clark, Geneva, Escambia, Baldwin, Mobile Cos. (Mohr); Mount Vernon (Ruth); Bay Minette (Macfarlane). — Georgia: Coleman (Harper). — S. Carolina: Barhamville, St. Johns (Porcher); Chesterfield, Summerville (Macfarlane). — N. Carolina: Gosborough (Rugel); Muddy Creek (Donnell-Smith); Hickory (Heller); Wake Co. (Ashe); bei Biltmore, Fayetteville (Beadle); Wilmington (Mc Carthy, Macfarlane). — Maryland: (Jones, Krieg). — Pennsylvania: Tinicum (G. Smith); Pike, Monroe, Lackawanna, Susquehanna, Tioga, Centre, Lancaster und Erie counties (Porter); Pocono Plateau (Macfarlane, Harshberger); Christiana, Cresco (Walton). — New Jersey: Berlin, Atco, Ancora, Toms River, Egg Harbor, Oceanville, Tuckahoe, Mount Pleasant (Macfarlane); Spring Garden

(Redfield); Winslow (Martindale); Mays Landing, Island Heights Junction (Harshberger). — Ohio: Burton (Ashcroft); Canton (Riehl); Silver Lake (Stair). — New York: Round Marsh (Pearce); Preston (Coville); Adirondacks (Manda); Ithaca (Rowlee); Lake Hopatcong (Nash). — Rhode Is.: South Kingston (Congdon). — Massachusetts: Beverley (Engelmann); South Warmingham (Sturtevant); Manchester (Oakes); Grantville (Sprague). — Vermont: Peacham (Stevens); Barnumville (Day). — N. Hampshire: Jaffrey (Robinson). — Maine: Oxford Co. (Herb. Gray). — New Brunswick: Charlo Restigouche (Fowler). — Nova Scotia: Prince Edward Island (Watson); Cape Breton Is., bei Halifax, Boylston (Macoun); Canso (Fowler); Digby, North Sydney (Lang). — Neufundland: Whitbourne (Robinson, Schrenk). — Labrador: Northern Labrador (Kinaston). — Manitoba: Carberry (Christy); Portage Tremblant (Bousingeau); Fort Chipewyan (Franklin). — Michigan: Cass Co. (Webber). — Indiana: Clark (Umbach). — Wisconsin: Madison (Hale). — Minnesota: sehr häufig (Macmillan); bei Minneapolis, Gull Lake (Ballard); South Fowl Lake (Wood); Winona (Holzinger); Duluth (Roberts).

Einheim. Namen: Pitcher-plant, Indian Pitcher-plant, Side-saddle Plant, Forefather's Cup, Devil's Boots, Huntsman's Cup.

Var. b. **heterophylla** (Eaton) Torrey, Nat. Hist. New York I. (1843) 41. — *S. heterophylla* Eaton Manual ed. 4 (1824) 445. — Flos luteo-virescens, sepala luteo-viridia, petala lutea, folia pallido-viridia.

Zuerst von Eaton beschrieben nach Exemplaren, die von Hunt (1818) in der Nähe von Northampton (Mass.) gesammelt waren. Später (1832?) wurde sie von Dr. Sartwell in Junius (Seneca Co. N. Y.) gesammelt; er belegte sie im mscr. (Herb. Torrey in N. York Garden) mit dem Namen *S. aurea*; 1892 fand sie Dr. N. L. Britton am Forked River, N. J., und 1893 Captain Bendire bei Wilmart, N. Y. (U. S. Nat. Herb.).

7. **S. psittacina** Michx.*) Fl. bor. amer. I. (1803) 311; Pursh, Fl. Amer. sept. II. (1814) 368; Torrey et Gray, Fl. N. Amer. I. (1838) 59; Croom in Ann. Lyc. Nat. Hist. New York IV. (1848) 101; Decne. in Fl. des serres VII. (1851) 268; Chapman, Fl. S. U. States (1860) 20; Masters in Gard. Chron. (1866) 1218; s. 2. XV. (1881) 817; DC. Prod. XVII. (1873) 4; Small, Fl. S. E. U. States (1903) 493. — *S. calceolata* Nuttall in Trans. Amer. Phil. Soc. s. 2, IV. (1834) 49. — *S. pulchella* Croom in Amer. Journ. Arts Sc. XXV. (1834) 75. — Rhizoma 10—12 cm longum, 5—7 mm diam., tenue, elongatum vel internodiis subnullis contractum, foliis apice caespitosis. Folia subtrimorphia; folia vernalia omnia ascidiformia 6—12 cm longa, ad galeam 1,5—4 cm lata, decumbentia, radiata, per hiemem persistentia; petiolus basi expansus, alatus, amplexicaulis, superne ± elongatus, cylindricus; ascidium ore tubulosum a basi ad os sensim expansum, supra os dilatatum galeatum, galea psittacoidea; ala ventralis a basi sensim ad $^2/_3$ longit. expansa dein abrupte usque ad os contracta; os ovoideum sub galea psittacoidea positum; peristomium involutum 1—1,5 mm latum; operculum reductum, solum inter apicem psittacoideum costae et os formatum; ascidium extus rarius viride vulgo viridi-rubrum, circum os et supra galeam rubro-venosum et albo-marmoratum, intus sub galea pilis deflexis et glandulis minutis onustum, infra os glabrum nitidum, basi pilis longis tenuibus deflexis instructum; folia aestivalia vernalibus subsimilia 10—25 cm longa, medio alae ventralis 2—6 cm lata, ascidio angusto elongato, galea reducta, sed ala ventrali magna, expansa, 2—6 cm lata; folia autumnalia squamiformia 7—10, 10—20 mm longa, conica, viridia vel viridi-rubra. Scapus 15—20 cm longus, 2 mm diam., flos ut in *S. rubra* parvus, 3—4 cm latus, etiam in fructu nutans; bracteae 5—8 mm × 4—5 mm, viridi-rubrae. Sepala 2—5 cm × 1,5—2 cm, ovata, apice obtusa extus rubra vel rubro-viridia, intus viridia margine rubra. Petala 3,5—4,5 cm × 1,5—2 cm, oblongo-obovata, infra medium leviter constricta et margine revoluta, basi pallido-viridia, supra rubro-maculata dein purpurea. Staminum filamenta infra alba, superne albo-rubra, apice rubra. Ovarium 5—6 mm sphaeroideo-depressum,

*) *Sarracenia »psyttacina«* l. c.

umbraculo styli 3—3,5 cm lato, luteo-viridi. Capsula 9—10 mm, sphaerica, leviter tuberculata. Semina 1,5 mm × 1 mm obovata, deltoidea, minute tuberculata raphe obscura.

In sandigen Sümpfen von Südcentral-Georgia und N.-W. Florida westlich bis nach Louisiana, und 150—160 km landeinwärts. Blütezeit erste bis dritte Woche des April.

Georgia: Court House, Tatnall Co. (Nuttall); St. Marys (Rugel); Tebeauville (Canby); Tifton, Reidsville, Moultrie, Okefinokee, Douglas, Higgston, bei Irwinville (Harper); Waycross (Williamson, Macfarlane). — Florida: Quincy (Rugel); Appalachicola (Curtiss); Tallahassee (Nuttall); De Funiak Springs (Curtiss); Sneads, Ochesee, Pensacola, Fort Barranca, Ponce de Leon (Macfarlane). — Alabama. Mobile (Curtiss, Sullivant, Mohr); Baldwin und Washington Co. (Mohr); Bay Minette, Flomaton (Macfarlane). — Mississippi: Ocean Springs (Skehan, Pollard); Biloxi (Tracy, Macfarlane); Bay St. Louis (Macfarlane). — Louisiana: Neu-Orleans (Drummond); Pearl River (Cocks); Alton (Macfarlane).

Hybridae artificiales*).

Sarracenia Drummondii × minor.

S. cantabrigiensis Lynch, ex Zahn in Gartenwelt XII. (1907) 82.

Im Bot. Garten zu Cambridge gezogen.

»Diese Hybride entstammt einer Kreuzung zwischen *S. Drummondii* und *S. variolaris*. Sie hat die charakteristische Schlauchform von *S. variolaris*, ist jedoch stärker im Wuchs und besitzt an den oberen Teilen der Kannen die schöngefärbte Markierung von *S. Drummondii*. Interessant ist, dass einige der Pflanzen tief scharlachrote Blumen bringen, wie *S. Drummondii*, während andre die gelbe Blüte von *S. variolaris* zeigen.«

S. excellens Nicholson, Dict. of Gard. III. (1887) 364. — »*S. variolaris* × *Drummondii alba*«. — Folia viridia, versus apicem reti denso purpureo-rubro maculata, maculae pallidae extus rubellae; operculum rotundatum, curvatum, cum tubi superiore parte fusco-rubro-maculatum et suffusum.

S. Drummondii × psittacina.

S. Wrigleyana Hort. Veitch ex Gartenfl. XXXVI. (1887) 398.

S. Drummondii × flava.

S. Moorei Hort. ex Gard. Chron. (1874) I. 702; Mast. in Gard. Chron. New Ser. XVI. (1881) 40 et 44 fig. 9; Nicholson, Dict. of Gard. III. (1887) 365. — *S. Mooreana* Hort. Veitch ex Gard. Chron. (1877) I. 425. — Folia ca. 2 ped. longa, erecta, alata, viridia, ore 4 poll. diam., operculum ca. 3 poll. latum, sessile, pilosum, reti venarum rubicundo spatia clariora includente. Flores 4 poll. diam., penduli, fragrantes, sepala viridula, extus roseo-tincta, petala extus roseo-rubra, intus pallide rubella, 2—3 poll. longa.

Nach D. Moore (Atti del Congr. intern. bot. Firenze (1874) 174), dem die Aufzucht des Bastards gelang, ist dies der Bastard *S. flava* ♀ × *Drummondii* ♂. Blüten nach Masters von sehr schöner Farbe, die Mitte haltend zwischen *flava* und *Drummondii*, die Petalen mehr gerundet als bei *Drummondii* und in dieser Hinsicht mehr an *flava* erinnernd.

S. Mandaiana Hort. Pitcher et Manda ex Gard. Chron. (1893) I. 455; Nicholson, Dict. of Gard. Suppl. (1901) 654 (*Mandaina*).

Cf. Cycl. Amer. Hort. IV. (1902) 1616 where it is regarded as an introduced natural hybrid (v. p. 22). Pitchers about 2 ft. long, trumpet-shaped and broad

*) Enumeratio hybridarum a H. Harms e litteratura sumpta, a cl. J. M. Macfarlane revisa; de hybridis in natura observatis cf. p. 21, 22.

at mouth, color light green with slight white mottlings. Lid large, broad, slightly incurved, margins undulate, dark green shaded with red and blotched with white. (Macfarlane).

S. exculta Nicholson, Dict. of Gard. III. (1887) 364. — Folia erecta, ala angusta, subtus et apicem versus cum operculo rotundato incurvato undulato pallide viridia, albido-maculata et rubicundo-reticulata. Medium tenet inter *S. flava atrosanguinea* et *S. Drummondii*.

S. Drummondii × purpurea.

S. Mitchelliana Nicholson, Dict. of Gard. III. (1887) 365 fig. 420. — »*S. Drummondii rubra × purpurea*«. — Folia curvata, infundibuliformia, apice latissima, olivaceo-viridia, reti venarum rubrarum subtili percursa, demum rubello-rubicunda; operculum cordato-reniforme, undulatum, reti distincto profunde rubicundo. Planta elegantissima.

S. Patersonii Hort. ex Gartenfl. XXXVI. (1887) 398.

»From its aspect and structure Macfarlane considers this to be *S. Drummondii × S. purpurea*. Raised by Dr. Patterson (Bridge of Allan, Scotland«).

S. flava × minor(?)

S. crispata Hort. Bull. ex André in Illustr. hortic. XXVII. (1880) 87 t. 387; Gard. Chron. New Ser. XV. (1881) 633, XVI. (1881) 9 (*S. flava crispata*); Nicholson, Dict. of Gard. III. (1887) 364. — Folia erecta, infundibuliformia; operculum erecto-curvatum, rotundatum, sicut superior tubi pars longitudinaliter rubro-striatum. Flores 7,5 cm diam.; petala alba, nutantia, margine reflexa.

»Either a hybrid of *S. flava × minor*; or *S. Sledgei* (vide p. 29), but the above quoted descriptions are too imperfect for accurate determination«. (Macfarlane.)

S. flava × purpurea.

S. Atkinsoniana Nicholson, Dict. of Gard. III. (1887) 364. — Folia elongata, angusta, erecta, viridia, costis levibus et nervis rubris; operculum latum, cordatum, viride, rubro-costatum et rubro-venosum.

Nach Nicholson eine hybride Form aus *S. flava maxima × S. purpurea*, am meisten der ersteren Art sich nähernd.

S. Stevensii Hort. ex Gard. Chron. (1874) I. 738; Mast. in Gard. Chron. New Ser. XVI. (1881) 40; Nicholson, Dict. of Gard. III. (1887) 366. — Folia ampla, erecta, venis prominulis, rectis, profunde rubicundis, spatiis venulis numerosis aeque coloratis percursis; operculum amplum, crispatum, profunde rubicundum.

Nach Masters ist dies *S. purpurea* ♂ × *flava* ♀. Der Bastard wurde von Mr. Stevens (Trentham) erzogen, ungefähr gleichzeitig mit *S. Moorei*.

S. Tolliana Nicholson, Dict. of Gard. III. (1887) 366. — Folia longa, angusta, infundibuliformia, ore truncato, margine recurvo, aut profunde purpureo-rubra costis et venis obscurioribus, aut viridula costis et venis purpureis, operculum late reniforme, undulatum, rubello-purpureo-reticulatum.

Soll nach Nicholson *S. Drummondii × flava* sein. Nach Exemplaren, die unter dem Namen *Tolliana* in Kultur sind, scheint jedoch der Bastard *S. flava × purpurea* vorzuliegen, und so werden die Exemplare auch in Cycl. Amer. Hort. IV. (1902) 1616 gedeutet (nach Macfarlane).

S. Williamsii Hort. ex Gard. Chron. (1874) II. 49, (1881) I. 629, (1881) II. 40; Nicholson, Dict. of Gard. III. (1887) 367. — Folia stricte erecta, pro rata brevia, infundibuliformia, paullo infra apicem constricta, profunde purpureo-rubicundo-costulata; ala venis purpureo-rubicundis; operculum latissimum, cordato-reniforme, costulis trichotomis

venulis minoribus conjunctis distincte notatum, intus arctius profunde purpureo-rubicundo-reticulatum.

Nach Masters soll dies ein natürlicher Bastard von *purpurea* × *flava* sein. Sehr schön ist der Kontrast zwischen den rötlich-lila Petalen und der grünlichen Griffelscheibe.

S. Wilsoniana Nicholson, Dict. of Gard. Suppl. (1901) 654.

S. flava × *rubra.*

S. Popei Hort. ex Gard. Chron. New Ser. XVI. (1881) 41; Nicholson, Dict. of Gard. III. (1887) 365. — Folia erecta, ca. 2 ped. longa, angusta, tubiformia; operculum 3,5 poll. diam. ovatum acuminatum. Flores 4 poll. diam.; sepala viridula, rubro-suffusa, ovato-oblonga; petala sepalis duplo longiora, oblongo-obovata, basi albida, ceterum velutino-rubicunda, pallido-luteo-marginata, intus pallide rubella.

Erzogen in Glasnevin, wo Mr. Pope die Aufsicht über die Sarracenien hatte.

S. minor × *purpurea.*

S. Swaniana Nicholson, Dict. of Gard. III. (1887) 366 fig. 420. — »*S. variolaris* × *purpurea*«. — Folia infundibuliformia, leviter incurva, viridulo-purpurea, tubo intus ut operculum arcte venis rubicundis reticulato; ala pro rata lata; operculum cordato-ovatum, apice bilobum.

S. minor × *psittacina.*

S. decora Hort. ex Gard. Chron. (1889) II. 250; Nicholson, Dict. of Gard. Suppl. (1901) 654. — »Probably between *S. psittacina* and *S. variolaris*«.

S. formosa Hort. Veitch ex Gard. Chron. (1881) II. 281; Gartenfl. XXXII. (1883) 318c; Nicholson, Dict. of Gard. III. (1887) 364 fig. 419. — *S. psittacina* × *variolaris.* — »The pitchers have more of the decumbent habit of *S. psittacina* than of the erect growth of *S. variolaris*, and are about intermediate in length between those of the two parents. The broad, lateral wing is also intermediate in form, while the beak-like lid of the pitcher is altogether that of *S. psittacina.* All the upper portion of the pitcher has a bright crimson, reticulated nervation, with the characteristic white spotting of *S. variolaris*; the basal portion is pale fulvous-green«.

S. Maddisoniana Nicholson, Dict. of Gard. III. (1887) 364; Gartenfl. XXXVI. (1887) 389; Gard. Chron. (1889) II. 81. — »*S. variolaris* × *psittacina*«. — Folia leviter erecta, brevia, lata, viridia, extus obscure venosa, ore pellucido-punctato; operculum amplum, supra tubum incurvatum, ovatum, undulatum, distincte venis profunde purpureo-rubris reticulatum. Habitus nanus.

S. purpurea × *rubra.*

S. Chelsonii Hort. ex Veitch Gard. Chron. VIII. (1877) 600, IX. (1878) 11, XIII. (1880) 722 et icon. 725, XV. (1881) 817; Ill. Hort. XXVII. 388; Nicholson, Dict. of Gard. III. (1887) 364. — »Leaves richly coloured with crimson of a brighter hue than those of either parent«.

Nach Nicholson eine schöne Hybride von *S. rubra* ♀ × *purpurea* ♂, zuerst bei Veitch auferzogen und 1877 ausgestellt. Die Kannen vereinigen die längliche Form derer von *S. rubra* mit der breiteren Dilatation derer von *S. purpurea.* Im Habitus steht der Bastard in der Mitte zwischen der niederliegenden *purpurea* und der aufrechten *rubra.*

S. purpurea × *psittacina.*

S. Courtii Hort. ex Gard. Chron. (1881) II. 381; Gartenfl. (1886) 29; Nicholson, Dict. of Gard. III. (1887) 364. — Folia statu juniore inde a medio apicem versus

nitide purpurea, venis atrioribus reticulata, vetustiora profunde sanguinea, venis atro-purpureis.

Schöne Hybride von *S. purpurea* × *psittacina*.

Hybridae variae praecipue inter species et hybridas paratae.

S. Cookiana Hort.

S. exornata Nicholson, Dict. of Gard. III. (1887) 364. — »*S. purpurea* × *crispata*«. — Folia eis *S. purpureae* similia, sed magis erecta, ore leviter angustata, os atro-purpureo-rubrum revolutum nitidum, tubus profunde viridis, venis purpureo-rubris obtectus, costulis longitudinalibus validis, venulis minoribus et subtilioribus conjunctis; operculum erectum, ovatum, undulatum, costulis atro-purpureo-rubris adscendentibus et divergentibus.

S. Farnhami Hort. Cult. in Hort. Kew. = ?*S. Drummondii* × *rubra*.

S. Flambeau Hort. Cult. in Hort. Kew. = ?*S. purpurea* × *minor*.

S. illustrata Nicholson, Dict. of Gard. III. (1887) 364; Hort. ex Gard. Chron. (1889) II. 81. — *S. flava picta* × *Stevensii*. — Folia longa, infundibuliformia, costulis longitudinalibus rubicundis venis similiter coloratis conjunctis distincte notata; operculum cordatum, apiculatum, viride, venis distinctis rubris curvatis notatum, venis exterioribus usque ad marginem extensis.

Im Habitus der *S. flava* ähnlich. *S. flava* × (*purpurea* × *flava*).

S. melanorhoda Hort Veitch in Gard. Chron. (1882) II. 281, (1881) II. 40; Nicholson, Dict. of Gard. III. (1887) 365 fig. 419. — *S. Stevensii* × *purpurea*. — Folia semidecumbentia, elongata, infundibuliformia diametro ab basi ad apicem sensim dilatata, statu maturo sanguinea, atro-rubicundo-venosa; ala lata; operculum erectum, crispatum, rubello-luteum, atro-rubicundo-venosum, facie versus os sita pilosa.

Ein Bastard der Formel *S. purpurea* × (*flava* × *purpurea*), da *Stevensii* eine Hybride von *flava* und *purpurea* ist. Erzogen bei Veitch. Im Habitus ähnlich *purpurea*.

S. Mesoniana Hort. ex Gard. Chron. (1889) II. 81 nomen.

S. Sanderae Nicholson, Dict. of Gard. Suppl. (1901) 654. — *S. Drummondii alba* × *Cookiana*.

S. Sanderiana Nicholson, Dict. of Gard. Suppl. (1901) 654. — *S. Drummondii rubra* × *Farnhami*.

S. vittata maculata Nicholson, Dict. of Gard. Suppl. (1901). — *S. purpurea* × *S. Chelsonii*; demnach *S. purpurea* × (*purpurea* × *rubra*).

S. Willisii Nicholson, Dict. of Gard. Suppl. (1901) 654. — *S. Courtii* × *melanorhoda*; demnach *S.* (*purpurea* × *psittacina*) × (*purpurea* × [*flava* × *purpurea*]).

Register

für J. M. Macfarlane-Sarraceniaceae.

Die angenommenen Gattungen sind **fett** gedruckt, die angenommenen Arten mit einem Stern (*, bezeichnet.

Aedes fuscus 18.
Aedes sapphirinus 18.
Bucanephoron Pluk. 27.
Bucanephyllon Pluk. 27.
Chrysamphora Greene 25.
californica (Torr.) Greene 26.
Cisti Adans. 1.
Cistiflorae 24.
Coilophyllum Morison 27.
Darlingtonia DC. 25.
Darlingtonia Torr. 25, n. 2. (2—5, 9—20, 22).
*californica Torr. 26, n. 1. (20, 23).
Darlingtonia Torr. 25.
Desmanthus Willd. 25.
Droseraceae S. F. Gray 23.
Euphoria melancholica 18.
Euryomia 18.
Exyra Ridingsii 17.
Exyra Rolandiana 17, 18.
Heliamphora Benth. 24, n. 1. (4—9, 11, 13, 15, 18, 19, 20, 22).
*nutans Benth. 24, n. 1. (5).
Nepenthaceae Lindl. 23.
Nepenthes Breyn. 27.
Nepenthes L. 4, 22, 23, 24, 27.
Neptunia Lour. 25.
Nymphaeaceae DC. 23.
Papaipema appassionata 18.
Papaveraceae B. Juss. 23.
Sarcophaga sarraceniae 18.
Sarracena Tourn. 27.
Sarracenia L. 27, n. 3. (2—4, 9—11, 15—24).
adunca Smith 28, n. 1.
Atkinsoniana Nicholson 36.
aurea Sartwell 34, n. 6.
calceolata Nutt. 34, n. 7.
cantabrigiensis Lynch 35.
Catesbaei Elliott 14, 29.
Catesbaei Small 29, n. 2. (31).
Chelsonii Hort. 37.
Cookiana Hort. 38.
Courtii Hort. 22, 37.
Courtii × melanorhoda 38.
crispata Hort. 36.
decora Hort. 37.
*Drummondii Croom 31, n. 4. (3—4, 6—9, 11, 12, 14—17, 19, 21—23, 28).
Drummondii Lindl. et Paxt. 31, n. 4.
Drummondii × Cookiana 38.
Drummondii × Farnhami 38.
Drummondii × flava 21, 35.
Drummondii × minor 35.
Drummondii × psittacina 35.
Drummondii × purpurea 22, 36.
excellens Nicholson 35.
exculta Nicholson 36.
exornata Nicholson 38.
Farnhami Hort. 38.
Fildesii Hort. 31, n. 6.
Flambeau Hort. 38.
*flava L. 29, n. 3. (2—4, 7—9, 11—18, 20—24).
var. f. atro-sanguinea Bull. 31, n. 3. (36).
var. crispata Mast. 29, n. 2.
var. erythropus Hort. Bull. 31, n. 3.
var. c. limbata Hort. Bull. 31, n. 3.
var. b. maxima Mast. 31, n. 3.
var. a. media Macfarlane 31, n. 3.
var. g. minima Mast. 31, n. 3.
var. c. ornata Hort. Bull. 31, n. 3.
var. d. Rugelii Shuttlew. 31, n. 3.
flava × minor 21, 36.
flava × purpurea 21, 22, 36.
flava × rubra 37.
flava × Stevensii 38.
formosa Hort. 37.
Gronovii Wood 30.
var. alata Wood 29, n. 2.
var. Drummondii Wood 31, n. 4.
var. flava Wood 30, n. 3.
var. rubra Wood 32, n. 5.
heterophylla Eaton 33, 34, n. 6.
illustrata Nicholson 38.
lacunosa W. Bartr. 31, n. 4. (28).
leucophylla Raf. 31, n. 4.
media J. Bartr. 33, n. 5.
Maddisoniana Nicholson 37.
Mandaiana Hort. 22, 35.
melanorhoda Hort. 38.
Mesoniana Hort. 38.
minor Sweet 32, n. 5.
*minor Walt. 28, n. 1. (4—9) 11—18, 20—22, 28).
minor × psittacina 22, 37.
minor × purpurea 37.
Mitchelliana Nicholson 36.
Mooreana Hort. Veitch 35.
Moorei Hort. 35.
nutans D. Dietr. 24.
Patersonii Hort. 36.
Popei Hort. 37.
*psittacina Michx. 34, n. 7. (2—9, 12, 14—17, 19, 22, 24, 28).
psittacina × variolaris 37.
pulchella Croom 34, n. 7.
*purpurea L. 33, n. 6. (3—9, 12—14, 16—19, 21—24, 28).
var. heterophylla (Eaton) Torrey 34, n. 6.
var. typica Macfarlane 33.
purpurea × Chelsonii 38.
purpurea × psittacina 37.
purpurea × rubra 37.
*rubra Walt. 32, n. 5. (3—4, 7, 8, 11, 12, 16, 21, 23, 28).
var. acuminata DC. 32, n. 5.
Rugelii Shuttlew. 30.
Sanderae Nicholson 38.
Sanderiana Nicholson 38.
*Sledgei Macfarlane 29, n. 2. (3—4, 7—8, 12, 15—18, 20—23, 28, 30, 31, 36).
Stevensii Hort. 21, 36.
Stevensii × purpurea 38.
Swaniana Nicholson 37.
Sweetii DC. 32, n. 5.
Tolliana Nicholson 36.
undulata Dene. 31, n. 4.
variolaris Michx. 28, n. 1. (35, 37).
variolaris × Drummondii alba 35.
variolaris × psittacina 37.
variolaris × purpurea 37.
vittata maculata Nicholson 38.
Williamsii Hort. 36.
Willisii Nicholson 38.
Wilsoniana Nicholson 37.
Wrigleyana Hort. Veitch 35.
Sarraceniaceae La Pylaie 1.
Sarrazinia Hoffmannsegg 27.
Styrax californicum Torr. 25.
Xanthoptera semicrocea 17.

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